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FORTY YEARS OF HELPING THE FARMER WITH KNOWLEDGE[1]

By Dr. W. H. CHANDLER

UNIVERSITY OF CALIFORNIA

IN 1900 the United States Department of Agriculture, state experiment stations, state agricultural colleges and secondary agricultural schools expended about two and a half million dollars, in 1940 more than a hundred and ten million dollars; this last includes the cost of vocational agriculture in high schools. In 1900 many of the colleges were still accepting students with little or no high-school training. Such subjects as mathematics, chemistry, physics and English were taught in courses about equivalent to those taught in high schools, and a considerable percentage of students enrolled in agricultural colleges were taking these courses to prepare for admission to other colleges. The teachers in agricultural subjects seemed to be exceptionally earnest and had developed forcefulness by their contact with robustly critical audiences at farmers' meetings. What most of them taught, excepting teachers in soil science, animal nutrition and entomology, was the result of reasoning from inadequate knowledge of plant and animal processes, experience of exceptional farmers who wrote for farm journals or talked in farmers' meetings and data from rather poor field trials that were beginning to be published.

Soon after 1900 new men were taken on rather

[1] Parts of the address as retiring vice-president and chairman of the Section on Agriculture, American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

rapidly in colleges and experiment stations, mostly men with good personalities who manifested an interest in agricultural problems and had completed only the rather superficial curricula for the bachelor's degree. These undergraduate courses had not been intensive enough to disclose capacity or lack of capacity to study such problems as they would encounter. Many of them never acquired as much scientific training as their teachers had. They tended to emphasize the view that they were practical rather than scientific. Some depended for success upon rather arrogant forcefulness and contact with the influential farmers and business men such as bankers and newspaper men. Many such business men had become interested in improving the farmers and were glad to support plausible efforts by such aggressive young men. Some of these men whose spirits were too animated for patient, effective study, accepted industrial employment during or following the first world war, with companies expecting to profit by farmers' increased purchasing power.

The ten or fifteen years following about 1900 may, I think, be called the propaganda era in agricultural education. With the purpose of uplifting the farmer quickly men were sometimes employed for extension activities who knew too much: a worker in one agricultural college said that his extension associate could make more discoveries during one lecture than the best scientific worker could make in a lifetime of research. Perhaps the dogma that was the subject of most sermons was that of the water-conserving effect of a dust mulch maintained by diligent cultivation. Yet one experiment station in seeking support now claims to have saved the farmers of its state ten million dollars a year by having discovered that the story of the dust mulch was not true.

By 1904 or a little later many of the agricultural colleges had entrance requirements as high as those of other colleges and the students took the same courses in chemistry, physics, mathematics, botany and zoology as students in colleges of letters and science. These better students tended to be critical of superficial, applied courses. When such students graduated and were employed in the colleges, they wanted to become as well trained as the botanists or zoologists. Somewhat before 1920 such young men were improving the teaching and research of the colleges considerably. Extension activities, however, continued to be of the propaganda type until the representatives of the colleges living near the farmers, the county agents, discovered its ineffectiveness or even harmfulness.

Shortly before and for a number of years after the establishment of farm advisers or county agents in the counties, as a result of the Smith-Lever act in 1914, much was said in extension central offices about salesmanship in presenting ideas to farmers. Extension offices were influenced by what seemed to me a very flatulent pedagogy. To some of the educational advisers the farmers were pathetically dull. One very impressive teacher, from a university that was insulated from farm problems by several million tenement dwellers, was at great pains to tell a convocation of county agents and extension specialists how they could improve their techniques by studying the Hearst newspapers, learning to express themselves in words of one syllable. The actual problem these workers faced was not dullness in the farmers but the uncertainty that what they would say would be true: intensity of personal interest accentuates the understanding of farmers.

Under such influences as these some of the earlier county agents undervalued detailed knowledge of crop and animal problems and overvalued smart politics: skill or imagined skill in manipulating farm groups in the interest of "objectives." In sections that I know, experience has tended to correct this evil. Being so close to the farmers, county agents receive very unpleasant reactions when their manipulations or their objectives prove not to be beneficial. Furthermore, they find that most of the questions good farmers ask can not be answered by any one except after new research, if at all. In the states with which I am acquainted, objectives, smart politics and other heroics have gradually receded, and farm visits, field trials, demonstrations at trial plots and quiet helpfulness at conferences and community center meetings have taken their place.

When a county agent finds questions of considerable importance to his constituents that he can not answer, he gets in touch with an extension specialist from whom he thinks he may obtain an answer. If the specialist can not answer, they consult some one in the experiment station or some conveniently located worker in the U. S. Department of Agriculture. If no one has the answer, a study of the problem may be started, probably in both the field and the laboratory, the county agent keeping interested farmers informed concerning progress of the study. Sometimes the procedure is in the opposite direction: a scientist who has started from leads in the fundamental aspects of his field of study may think he has made discoveries of value to farmers. If he is moderately humane, he does not write a spectacular story for the newspapers and risk causing unwise investments. Instead, he will get trials made cautiously through county agents where the discovery is most apt to be useful.

Probably as many well-trained scientists are doing research in the U. S. Department of Agriculture as in all the experiment stations. I am acquainted only with some parts of the Bureau of Plant Industry; workers in these tend to cooperate with county agents

and with the experiment stations and avoid bringing confusion and ill-considered practices onto the farms. Every worker in plant science must be interested in this bureau. In recent years it has been searching the group of graduate students in plant science for the very best men in all the different aspects of botany: probably nearly half the well-trained young men in plant science in the country are in it. Being held each to the solution of certain definite problems, these men bring to their work a continuity of effort that is not always possible for teachers or even for experiment station workers with local obligations. They can follow their leads across state lines or even into foreign countries. They tend to work on problems that the best plant scientists have recommended as needing the comprehensive study a large organization rather well supplied with funds can support. If funds for maintenance of this bureau should be reduced, a considerable part of its special value would be lost, and growth of plant science as well as help to the farmer would be retarded.

County agents are learning, I think, that for effective help on problems that arise in their counties, they must find men whose thinking concerns the processes and responses of crops and animals rather than practices. Little initial help comes from mere trials of practices: farmers' rough trials over wide areas and throughout the years seem to have given nearly all the information that can be given by simple comparisons of practices. In fact, one noted experiment station director has said that experiment stations of the world have spent millions of dollars proving that farmers are right.

Nearly all the information that has enabled farmers to protect their crops and animals against diseases, animal parasites and malnutrition has been obtained by use of techniques in basic sciences such as chemistry, physics, botany or zoology. To become effective in studying crops or animals, or their parasites or soils, and safe in teaching the results of such studies, a man must acquire good training in one or more of these basic sciences and a skeleton of orderly, detailed knowledge concerning the processes, environmental responses and other characteristics, of the group of crops, animals, parasites or soils that constitute his field of study. The graduate student in horticulture, for example, should obtain as much training in chemistry and botany as workers in botany obtain, and this skeleton of knowledge about his class of horticultural plants besides. Even if his undergraduate curriculum contained as much science as a curriculum for students in botany would contain he will need more time for his training than a graduate student in botany would need. Students whose undergraduate training was in schools of chemistry or of letters and science with science majors, are coming to be preferred as graduate students in some departments of soil technology, plant pathology, horticulture, agronomy and other fields in agricultural science; and if applied agricultural courses come to precede courses in sciences in all agricultural colleges, the new workers on agricultural problems are apt to be nearly all from colleges of chemistry or of letters and science.

The system of publishing technical papers, piecing together systems of knowledge about plants, animals or soils, for example, is indispensable for effective aid to farmers. Attempts at graduate or undergraduate teaching or advice to farmers would be hopeless shams without it. A man may be exceptionally well trained when he leaves the graduate school and hopelessly deficient within ten years if he does not have ready access to this growing literature; and, valuable as the county agent is, he would be helpless without the aid it gives him directly, by his own reading, or indirectly, through his contacts with scientists who read it.

This literature, I am convinced, could be used more extensively and more effectively by workers and students if it were published in an orderly system of journals each filed in definite places in libraries and coming regularly to the desks of members of societies for special fields such as horticulture or plant pathology. Such society journals, each publishing all the papers in the country or even in a larger unit, in a fairly well-defined field would not only enable members to use all the new data in their fields more quickly and effectively, they would also give workers in related societies more ready access to such of these data as they might need. The data would probably be more accessible also because presented with less cumbersome discussion and review of literature. Journals published by chemical societies seem to have developed the best system of reporting only records and discussion enough for the needs of workers who use them. Biological societies, such as the American Botanical Society, seem to me to be making great progress in this regard. Apparently, however, they have fewer paying members who do not publish and the nature of their problems make longer reports necessary, so that the dues of such a society will not pay for publishing nearly all data obtained by members. A periodical such as the *Journal of Agricultural Research* that publishes papers from many fields usually does not go regularly to the desk of workers; and if it did it would contain such a large percentage of papers in which a worker is not interested that he would not be apt to develop the habit of examining it carefully. Even a journal of this kind, however, has a great advantage over papers published by experiment stations: it is usually edited by men free from close association with the authors. The average paper in the *Journal of Agricultural Research* seems to me to

present its data very much less cumbersomely than the average experiment station technical paper. Because of this cumbersomeness and editions much larger than enough to supply all really interested libraries and workers, publishing in experiment station technical papers is much more expensive than publishing in journals. Experiment stations could publish much more usefully by buying space in journals, and some experience convinces me that they could save 75 to 90 per cent. of their printing cost for technical papers.

Very few men with money for endowments have given support to journals of special scientific societies. By giving only to separate research institutions, they seem to me to be supporting the tool houses around the temple that is being built and ignoring the temple. If they gave to society journals, each a well-placed part of an orderly system of publishing data, they would be improving the breadth of knowledge and vision of teachers and research workers; and at the same time they could be certain that for every dollar they gave to promote economical, effective publication, they would prevent research institutions from spending two or three to ten dollars for expensive, cumbersome publication. In other words, they would be contributing more toward actual conduct of research than if they gave the money directly to the research institution.

Obviously, only a small percentage of graduates of colleges of agriculture can become resident or extension teachers or county agents or research workers. A considerable number obtain positions in which they do not use any of the training they received at college. Observations at a few institutions make me think that agricultural graduates whose training is built around some science, especially chemistry, and those whose training includes a considerable amount of economics are a little more apt to obtain acceptable positions than others. And I believe the boy who goes back to a farm of his own and who is mentally able to use college training will find orderly knowledge of the chemistry and other characteristics of his soils, crops and animals, more helpful in decisions he must make in managing his farm than knowledge from courses built around farm practices.

Men who worked for the establishment of agricultural colleges, and early teachers in the colleges, expected nearly all graduates to operate farms. Rather few have done so, long. A large percentage have not had farms large enough to earn a living, and farm employment rarely can pay enough to permit accumulation of capital. Furthermore, no kind of college training seems to give the graduate as great an advantage in competition with farmers trained merely by farm experience and observation in their communities as was expected. In some states, perhaps because of disappointment at the rather small number of agricultural college graduates who return to the farm, secondary agricultural schools have been established. And a system of high-school training in agricultural subjects has been established throughout the country.

A difficulty that all systems of training for farming encounter is the fact that there are not enough farms for all boys born in country districts: unless an increasing number of farms are to be too small to earn a living for a family or some invention makes small manufacturing units on a farm possible, about a third of the boys born in country districts must find employment off the farm. From experience of other countries and observation in this, we can, I think, be certain that the more farmers we have above the number necessary to farm all the land well, in units large enough to support a family with at least the bare necessities, the smaller the total yield from the farms will be. For when the farm is too small the farm and the family will tend to compete: money that is needed for fertilizer or for better seed may have to go to the family for some desperate need, or the urgency for cash from a single crop such as cotton may prevent rotation of crops to maintain soil fertility. Education, therefore, can not wisely be directed toward keeping more boys on the farm, actually to reduce the national income. When farms are so small that three men are doing the work that two could do as well, the extra farmers will not be contributing as much to the national good as a WPA worker using a shovel to make a road that could be made at a small percentage of the cost with good machinery; for the surplus farmers actually reduce the national income, and we *do* have the road for our payment to the WPA worker.

A school can rarely determine in advance which boy should stay on the farm. Teaching agriculture to a boy who never farms will, perhaps, do no other harm than prevent him from learning something else that would be more helpful to him. If the teaching, however, causes him to remain on the farm and if he finds after he has a family that he made a mistake, it, of course, does him great harm. People who are so anxious to have agriculture taught as widely as possible seem to me to undervalue a good farm as an educational institution. Young men have always improved their farm practice by observing good farms in their neighborhoods. Since the county agent system has become effective, a good farm has become an even better educational institution. On it all knowledge is being used that is known to apply and trials of new discoveries are apt to be in progress. Work on such a farm is probably the best training for actual farming that a boy can obtain.

Of the hundred and ten million dollars expended in agricultural research, extension and resident in-

struction, somewhat more than fifteen million are for special high-school classes in vocational agriculture under the Smith-Hughes act. Such observations as I have made suggest that nearly all the training of these teachers beyond their undergraduate years is in teaching methods and that after they begin teaching their contacts are with men whose interest is in teaching problems rather than with men who are associated with, and trained to evaluate, the growing body of knowledge about crop, animal and soil problems. In other words, these teachers who have a very great influence on many a boy's life seem to me to be guided by too much pedagogy and too little truth. There seems also to be in the system too much of the point of view in the propaganda era; and the students seem to be taught to expect too great an advantage from these courses when they begin competition with farmers whose knowledge was gained by experience: some of the projects suggest a view that these students will be able to succeed where whole groups of experienced farmers have failed. Some may, of course, succeed in growing and selling breeding stock because of the advertising the project gives them. To win a prize in a Future Farmers of America contest gives economically valuable publicity. The integrity we like to expect from men engaged in any kind of teaching, however, and especially teaching of agricultural science for which confidence has been cultivated at great public expense, demands that these conspicuous successes be not advertised unless the careers of nearly all students in the same classes are studied to see how many are benefited and how many are misled into staying on the farm to fail because of too little capital or unfortunate location, failing perhaps after they have families and find making a change to employment in other industries nearly impossible. In some districts Smith-Hughes teachers are anxious to have as many students as possible, sometimes taking students who go on to college and are handicapped by lack of basic training. If such a student goes to an agricultural college that permits him to take applied courses without science prerequisites he is apt to face life at graduation without opportunity for employment at any work that requires a technique, probably without money to start farming, without experience enough in any basic field to know whether or not he is suitable for graduate work, and with so little basic training that four or five years of graduate work would be required to prepare him for good teaching or research.

Many very fine young men are going into Smith-Hughes work. I believe they would serve farm life more safely and usefully if many of them were employed as special assistant county agents to give attention to young men who are actually beginning to farm instead of having to give so much of their time to boys who will not or should not farm; and if those in the high schools taught mainly the nature and operation of farm machinery, so that whether the boy leaves the farm or stays on it he may find use for what he has learned.

With the Smith-Hughes teaching as now organized, the grave responsibility the teachers assume and their isolation from men trained to study farm problems should cause them to seek the closest possible association with county agents, who have good contacts with both scientists and economists. Help of the county agent, I believe, should always be sought in directing and interpreting Smith-Hughes projects on farms.

I believe that in the school system too many grave, economic decisions are made by reasoning from pedagogic data or pedagogic dogmas. When a boy decides to stay on the farm or the teacher encourages him to do so, an economic decision is made. Either the schools should have the advice of men well informed concerning the long-time agricultural outlook and the relation of farming to other parts of the industrial system or teachers should confine themselves to developing aptitudes in basic fields of study or certain handicrafts, and should avoid activities that tend to choose a boy's lifework for him. Certainly a teacher should be reverently modest before the overwhelming complications a boy faces when he is considering farming for a lifework. Great harm can be done by the utterances of pompous high priests of the school system:

> The most important crop is the human crop.
>
> Any community that lets its young men get away is a dead community.
>
> The only place to keep them in the community is on the farm.

I believe good might follow if over the desk of every research worker and every extension worker and every agricultural and soil conservation worker and every teacher, especially every educational administrator, this motto were placed: "Blessed are the meek for they will not mislead their brothers with poorly considered teachings or strutting shams." The God of Nature reveals his laws, I believe, very rarely to the propagandist or to the pompous, or even to the merely zealous, but rather to him who trains diligently in the technique and the records of a system of knowledge, who records his own observations clearly and briefly for the benefit of all workers, who reviews and reorganizes his knowledge frequently in the light of new discoveries, who consults as frequently as possible with workers in his field and related fields, hoping for a vision that points to a safe advance in human welfare, and who is meek enough to see a vision unobscured by projections of himself.

OBITUARY

FRANK COLLINS BAKER

FRANK COLLINS BAKER has been widely recognized as an authority on fresh-water mollusca, on Pleistocene invertebrate paleontology and on museum administration. Born on December 14, 1867, he devoted a long life-time to the services of science. Most of his official positions have involved museum work and research, but through his scientific displays, his genial and kindly personality, and his ambitious program of publication he has had more influence upon the works of others than many who have devoted their whole time to teaching and to the direction of research.

In his concept of a museum were combined the functions of display, teaching and research. For the University of Illinois, where he served as curator of the Museum of Natural History from 1918 until his retirement as curator emeritus in 1939, he built one of the finest teaching museums in this country. At the same time he was amassing study collections in various fields of zoology, archeology and paleontology and carried on a very extensive personal program of research. With his death on May 7, 1942, his broad influence in the several fields of his immediate interests will be felt keenly.

His studies on mollusca were begun in the days when entire attention was focused upon the shells, but he became one of the early investigators to develop the field of malacology. At the time of his death, he had completed the typescript for the first volume of a proposed two-volume monograph on Planorbidae, in which morphology of these snails is treated in exhaustive manner.

Mr. Baker secured his early training at Brown University, in the Philadelphia Academy of Sciences and in the Ward's Natural Science Establishment at Rochester, New York, where so many museum specialists of the earlier generation served an apprenticeship.

In 1894, he became curator of zoology in the Field Columbian Museum of Chicago, but left that post the same year to become curator of the Chicago Academy of Sciences, a position which he held until 1915. From 1915 until 1917 he carried on an intensive quantitative study of relations of bottom fauna in lakes to fish life for the New York State College of Forestry of Syracuse University.

On the invitation of President E. J. James, he came to the University of Illinois as curator in 1918. Here, at the height of his career, he carried forward the development of the university museum at the same time that he was prosecuting a most ambitious research program. Only a few of his major publications can be mentioned here.

In 1911, his "Lymnaeidae of North and Middle America" came off the press and after more than thirty years is still regarded as the most comprehensive treatise on this family. His two volumes on the "Mollusca of the Chicago Area" (1892 and 1902) have been widely used.

After coming to Urbana, he completed "The Life of the Pleistocene," which the university published. This book gained for him very general recognition as a paleontologist. His work in this field was recognized through his election as fellow of the Geological Society of America and by appointment as consultant in Pleistocene invertebrate paleontology on the staff of the Illinois State Geological Survey. The Zoological Society of London honored him by election to corresponding membership in recognition of the soundness of his works.

His two volumes on the "Mollusca of Wisconsin" (1928) are recognized as one of the most comprehensive regional studies of American fresh-water mollusca. The field work for this study was carried on through several summers as a member of the staff of the Wisconsin Geological and Natural History Survey.

In 1939, the Illinois State Natural History Survey published the results of his life-long study of land snails in a "Fieldbook of Illinois Land Snails," to which he had brought two summers of uninterrupted field study on the Survey staff.

In recent years, responsibility for coordination of some programs of field studies in archeology and an interest in the mollusca used by prehistoric races opened up yet another field of activity in which he made several contributions.

He was a regular contributor to the pages of *Nautilus*, where numerous shorter papers on mollusca were published through the years. At the time of his death he was serving as president of the American Malacological Union. It was his fortune to witness the change of museums from "cabinets of curiosity" to educational institutions. He had likewise watched the expansion of the amateur field of conchology to a more mature science. His studies on detailed morphology and on ecological relations of mollusca to their environment have played a part in this transformation.

H. J. VAN CLEAVE

RECENT DEATHS

DR. JOHN M. T. FINNEY, professor of surgery emeritus at the Johns Hopkins University, died on May 30 in his seventy-ninth year.

DR. JAMES D. TRASK, associate professor of pediatrics at the Yale School of Medicine, known for his work on infantile paralysis, died on May 24 in his fifty-second year.

DR. GEORGE P. ENGELHARDT, who retired in 1930

after serving for twenty-eight years as curator of the Department of Natural Sciences of the Brooklyn Museum, died on May 24, at the age of seventy years.

DR. ROY MACKAY, associate professor of mathematics at New Mexico State College, died on May 12, at the age of thirty-eight years.

SCIENTIFIC EVENTS

1941 STALIN PRIZE-WINNERS IN THE U.S.S.R.[1]

OVER two hundred and fifty people—scientists, engineers and inventors—innovators of science and technique—have been honored with the title "Stalin Prize-winners." Through their creative work they have all enriched Soviet science with new achievements.

Among Stalin prize-winners we find names of eminent scientists of the Soviet Union—academicians and professors. The body of academicians and professors are under the guidance of the president of the Academy of Sciences of the U.S.S.R., V. Komarov, and have conducted work in the development of national economy among the Urals under these wartime conditions, for which they have merited and been awarded the First Degree Stalin Prize.

The works of many Soviet physicists are widely known both in the Soviet Union and abroad. Works of the academicians Joffe, Mandelstam and Papalexi are new achievements in the field of physics in the Soviet Union.

The wise investigations of semi-conductors by Joffe have cast light on a very important and complicated question in physics. He has worked out theoretical principles for semi-conductors in industry. On the basis of Joffe's works it has become possible to obtain conductors with many desired properties—new current rectifiers; investigations on photo-conductivity and thermo-electricity have given new powerful thermo-elements ten times superior to those available. For this outstanding work Joffe has been awarded the First Degree Stalin Prize in the department of physico-mathematical sciences.

For many years physicists have been endeavoring to solve the involved problem of ascertaining the nature of distribution of radio waves near the earth's surface. Two Soviet physicists, Mandelstam and Papalexi, have found a successful solution to this problem, for which they have been adjudged Stalin Prizes.

The Stalin prize-winners include the eminent Soviet mathematician, Academician Bernstein, author of numerous works on the theory of probability and the theory of approximated methods of computation. The Soviet mathematician, Khristianovich, has worked out a high theory, near sound-velocity aerodynamics, and has furnished, scientifically, grounded calculations for fast aircraft, thereby meriting the Stalin Prize award.

The numerous investigations in the domain of organic chemistry by Academician N. Zelinsky have played a big part in the technology of motor fuel, synthesis of aromatic carbohydrates, and in the sphere of defense chemistry. His work, published in 1941, contains about four hundred original investigations, for which he has been adjudged the Stalin Prize.

Satpaev, Kazakh geologist, has theoretically worked out the morphology and genesis of Djezkazgan in cuprous sandstone and has supplied valuable conclusions regarding the deposits of copper, iron, manganese and polymetallic ores and coal of Kazakhstan.

In the domain of the science of biology, the First Degree Stalin Prize has been awarded to Professor Y. Parnas, of the Ukrainian Academy of Sciences. In his work, "Gyco-genesis," Parnas crystallizes his numerous investigations on metabolism in muscles; this work, which he conducted at the Lvov University, has now been destroyed.

Biologists adjudged Stalin Prizes include Professor A. Zavarzin. A remarkable work by the author, "Evolutional Histology of the Nervous System," illustrates his theory of evolution of the nerve tissues and of the nervous system, from the simplest organisms up to man. All conclusions are built up on the vast amount of material collected and generalized by the author.

One of the most remarkable scientific works in the domain of medicine is entitled "Particular Pathological Anatomy," by Academicians Abrikosov and Anichkov. The authors have crystallized a tremendous volume of material worked out by them, and have made great contributions to Soviet medical science.

Stalin Prizes likewise have been awarded to the outstanding surgeon, Professor Yudin, for his eminent work on military-field surgery, and also to the famous Leningrad surgeon, Petrov, the outstanding specialist on oncology and cancerous diseases of the stomach.

Under these conditions of the patriotic war, agricultural science acquires particular importance, as it is called upon to help Kolkhoz peasantry ensure provisions for the army and workers of the Soviet Union. The Stalin prize-winners include one of the country's leading zoo-technicians, Dyakov, the author of several

[1] Statement by Vice-chairman Stalin for the Prize-winning Committee, S. Kaftanov, *chairman*.

works on the feeding of livestock. Dyakov has worked out and introduced the individual feeding of livestock, and has also elaborated upon the principles of the combined-fodder industry.

Stalin prizes have also been awarded for the best works of historico-philologic sciences, including collective work group authors, under the guidance of V. Potemkin, "History of Diplomacy."

ANTHROPOLOGICAL SURVEY OF THE PEOPLE OF THE UNITED PROVINCES OF INDIA

ACCORDING to *Current Science,* a monthly Indian journal corresponding in scope to *Nature* and SCIENCE, the Government of India on the recommendation of the census commissioner for India has sanctioned a grant-in-aid for the statistical analysis of the anthropometric data collected by Dr. D. N. Majumdar, of the Lucknow University, in collaboration with the late census superintendent of the United Provinces in respect of the castes and tribes of the provinces. In view of the scientific importance of the work the Statistical Laboratory, Calcutta, under the direction of Professor P. C. Mahalanobis, has agreed to share half the cost of this analysis out of its own funds. The total cost is estimated at Rs.9,000.

Measurements relating to about 4,000 individuals have been collected in accordance with accepted modern technique. The material offers a valuable opportunity for a critical and scientific examination of the very foundations of Indian anthropometry. An appropriate statistical tool is available in the Generalized Distance (D^2-Statistic) the validity of which was fully acknowledged by Professor R. A. Fisher in his paper on "Statistical Utilization of Multiple Measurements" (*Annals of Eugenics,* 1938, 8, 376). It has not been possible, however, to use this new tool so far for lack of suitable material.

It is pointed out that a detailed analysis of the anthropometric material collected now will help in solving the basic problems of comparative anthropometry. It will show, for example, how far the generalized distance can be used for an objective classification of castes and tribes or races of human beings. Secondly, it will enable a standard panel or list of measurements being selected for comparative purposes. This will not only simplify and standardize the procedure of field work in anthropology but will enable valid comparisons being made between measurements taken by different observers. Thirdly, it will enable a critical comparison being made between results based on physical and cultural methods of study. Finally the proposed analysis will supply a scientific basis for the comparative anthropology of the United Provinces and North India generally.

A joint report by Professor P. C. Mahalanobis and Dr. D. N. Majumdar will be submitted to the government of India. Besides this survey, a monograph on some of the important tribes and castes of the United Provinces will also be published for which the Provincial Census authorities have already sanctioned Rs.1,500.

THE INTERNATIONAL GRADUATE SCHOOL EXCHANGE

THROUGH the generosity of the W. K. Kellogg Foundation of Battle Creek, Mich., the Pan American Congress of Ophthalmology announces the establishment of an international graduate student exchange. With the cooperation of the Department of State of the United States Government, twenty-five graduate physicians from Latin America will be brought to the United States for graduate training in ophthalmology. They will be assigned in turn to seventeen of the leading ophthalmic institutions to serve as accessory residents for a minimum of one year, or longer if they show unusual ability. The traveling expenses to and from the country of origin will be paid and each man will receive one thousand dollars a year from the foundation.

The Latin American physicians will be chosen by a committee in each country composed of the dean of the medical school, the professor of ophthalmology and an already existing committee of the American Legation under the supervision of the Department of State. The number of scholarships allotted to each country will be based upon the population and upon the number of ophthalmologists in the country. Applications must be filled through the local professor of ophthalmology and forwarded to the secretaries of the Pan American Congress of Ophthalmology. Those south of Panama are to be sent to Dr. M. Alvaro, São Paulo, Brazil, and those north to Dr. Conrad Berens, New York City. Each application must contain full information regarding the candidate and must bear an exhaustive endorsement by the professor of ophthalmology. After preliminary consideration by the secretarial board of the congress the applications will be returned to the local committees for the selection of candidates. Information about the selectees will be sent by the local committees through the secretaries of the Pan American Congress of Ophthalmology to the foundation for final acceptance.

The following institutions are participating:

The Massachusetts Eye and Ear Infirmary; the Ophthalmic Institute of Columbia University; Bellevue Hospital and College; New York Eye and Ear Infirmary; Wills Eye Hospital of Philadelphia; Wilmer Institute of the Johns Hopkins University; the University of Michigan; the University of Cincinnati; Northwestern University; the Illinois Eye and Ear Infirmary; Cook County Hospital; the Mayo Clinic; the State University of Iowa; Washington University of St. Louis; Tulane University

in New Orleans; Leland Stanford University, and the University of California.

WESTINGHOUSE RESEARCH FELLOWS

DR. E. U. CONDON, associate director of the Westinghouse Research Laboratories, announces that three scientific men selected from leading universities have been awarded fellowships to carry on their investigations at the laboratories. The appointees are Dr. Russell E. Fox, University of Virginia; Dr. Gerson S. Schaffel, Carnegie Institute of Technology, and Dr. Robert S. Weisz, Cornell University.

At the Westinghouse Laboratories, Dr. Fox will carry on research on the dynamics of high-speed machinery which he began at the University of Virginia under Professor J. W. Beams. Dr. Schaffel will engage in research on the chemistry of polymers, a basic substance of all plastics, and Dr. Weisz will work in the field of ceramics, specifically attempting to improve the properties of electric porcelain.

This is the fifth group to be selected under the Westinghouse Research Fellowship plan inaugurated in 1938. Appointments are for one year, with reappointment for a second year if mutually desirable. In the past these men have devoted their entire time to investigations in the realm of pure science. This year, however, they have been asked to indicate the fields in which they feel qualified to contribute to war research if their assistance should be required. Three of last year's appointees now are engaged in war research.

Of last year's fellowship winners, Dr. Thomas W. Dakin, Harvard University, has been reappointed for a second year's study. Dr. James S. Koehler, of the University of Pennsylvania, has been granted a year's leave of absence to act as instructor of physics at the Carnegie Institute of Technology. Three other 1941 appointees have joined the Westinghouse research staff. They are Dr. Daniel Alpert, Stanford University; Dr. John W. Coltman, University of Illinois, and Dr. Theodore Holstein, New York University.

THE INDUSTRIAL RESEARCH INSTITUTE

THE fourth annual meeting of the Industrial Research Institute was held in Cleveland, Ohio, on May 22 and 23, with headquarters at the Hotel Statler. Over fifty industrial executives and research directors participated in round table discussions which dealt chiefly with the adjustment of research programs and personnel to meet war conditions.

H. S. Benson, administrative engineer, Research Division, United Shoe Machinery Corporation, Beverly, Mass., was elected chairman, and Wm. R. Hainsworth, vice-president, Servel, Inc., New York, vice-chairman, of the executive committee for the ensuing year. Two new members of the committee were also elected for three-year terms, Philip W. Pillsbury, president of the Pillsbury Flour Mills Company, Minneapolis., and Harold K. Work, manager of research and development, of the Jones and Laughlin Steel Corporation, Pittsburgh.

Guest speakers at a dinner session on Friday evening were Dr. George Crile, the Cleveland surgeon, and his associates, Dr. Otto Glasser and Dr. D. P. Quiring. They described their researches into the nature of the living cell, which have been carried on for the past ten years under the auspices of the Cleveland Clinic Foundation. Inspection visits to the new Thompson Aircraft Products Company plant at Euclid, Ohio, and the General Electric Institute at Nela Park, occupied the members and their guests on Friday afternoon.

The Industrial Research Institute, an affiliate of the National Research Council, undertakes to promote improvement of methods and more economical and effective management in industrial research through the cooperative efforts of its members. The membership is composed of forty-five industrial concerns maintaining research laboratories. Their chief executives in charge of research represent them in the activities of the institute, which has headquarters in Chicago. Other members of the executive committee are F. W. Blair, chemical director, the Procter and Gamble Company, Ivorydale, Ohio; Caryl P. Haskins, president, Haskins Laboratories, New York; Maurice Holland, division of engineering and industrial research, National Research Council, New York, and R. C. Newton, vice-president, Swift and Company, Chicago.

SCIENTIFIC NOTES AND NEWS

BATES COLLEGE, at its commencement exercises on May 24, conferred the doctorate of letters on Dr. Harlow Shapley, director of the Harvard College Observatory.

AT the ninety-second annual commencement exercises of the University of Rochester on May 11, the honorary degree of doctor of science was awarded to Dr. Sewall Wright, distinguished service professor of zoology at the University of Chicago, and to Dr. Frederick Fuller Russell, emeritus professor of preventive medicine and epidemiology at Harvard University.

THE University of New Mexico at its commencement exercises on May 11 conferred the degree of doctor

of laws on Professor Douglas Johnson, of Columbia University, who delivered the commencement luncheon address. He spoke on the necessity of employing properly controlled force for the maintenance of law and order in all organized society, international as well as national.

THE degree of doctor of engineering was conferred on May 25 at the commencement exercises of the University of Maine on Wilbur L. Merrill, head of the works laboratory of the General Electric Company at Schenectady, N. Y.

THE Charles B. Dudley Medal of the American Society for Testing Materials will be presented on June 24 at the annual meeting in Atlantic City to Dr. Francis C. Todd, assistant professor of petroleum and natural gas engineering at the Pennsylvania State College, and to Dr. A. W. Gauger, director of the mineral industries research. The medal is given for a paper read at last year's meeting on "Studies on the Measurement of Water Vapor in Gases."

Nature reports that Dr. Adolf Windaus, professor of chemistry at the University of Göttingen, known for his researches on vitamins, has been awarded the Goethe Medal for Art and Science on the occasion of his sixty-fifth birthday.

DR. GUSTAV EGLOFF, director of research of Universal Oil Products Company, was elected president of the American Institute of Chemists on May 16 at the annual meeting of the institute, held at Atlantic City. Dr. Egloff was the recipient in 1940 of the gold medal which is awarded annually by the institute to the man adjudged to have made significant contributions to chemistry and the welfare of the chemical profession during his career.

DR. CHARLES J. IMPERATORI, of New York, was elected president of the American Laryngological Association at the sixty-fourth annual convention of the association at Atlantic City. Dr. Harold I. Lillie, of the Mayo Clinic, Rochester, Minn., succeeded Dr. Arthur Walter Proetz as first vice-president.

AT the annual meeting of the American Association of Botanical Gardens and Arboretums the following officers were elected: Dr. Donald Wyman, Arnold Arboretum, Harvard University, *Chairman;* Henry T. Skinner, Morris Arboretum, University of Pennsylvania, *Vice-chairman;* Clarence C. Godshalk, Morton Arboretum, *Secretary,* and John C. Wister, Arthur Hoyt Scott Foundation, Swarthmore, and Dr. C. Stuart Gager, Brooklyn Botanical Garden, directors.

IN honor of Dr. Béla Schick, who is retiring after serving for nineteen years as head of the department of pediatrics at Mount Sinai Hospital, New York City, a fund of $2,000 has been raised by pupils, associates and friends to establish Béla Schick Lectures in his honor.

DR. GEORGE W. THORN, associate professor of medicine at the Johns Hopkins University, has been appointed Hersey professor of the theory and practice of physic at the Harvard Medical School and physician-in-chief of the Peter Bent Brigham Hospital, to succeed Dr. Soma Weiss, who died recently. Dr. Thorn's best-known work has dealt with the treatment of disease of the endocrine glands, particularly with the treatment of insufficiency of the adrenal glands.

DR. JEAN A. CURRAN, for the past five years dean of Long Island College of Medicine, Brooklyn, has been elected president of the college. He succeeds Dr. Frank L. Babbott, who retired last September.

ARTHUR B. RECKNAGEL, since 1913 professor of forestry at Cornell University, has been appointed head of the department of forestry. He succeeds Professor Ralph S. Hosmer, who will retire on July 1.

DR. LAURENCE MONROE KLAUBER, vice-president of the San Diego Consolidated Gas and Electric Company and curator of reptiles in the San Diego Society of Natural History, has been appointed lecturer in natural history at Stanford University.

DR. ORLANDO PARK, professor of zoology at Northwestern University, has been named honorary curator of zoology of the Chicago Academy of Sciences.

DR. RANDOLPH T. MAJOR, director of research of Merck and Company, Inc., Rahway, N. J., has been appointed to the Graduate Council of Princeton University.

ORR GOODSON has been appointed acting director of Field Museum of Natural History, Chicago, during the absence on war duty of the director, Lieutenant-Colonel Clifford C. Gregg.

DR. LOWELL J. REED, professor of biostatistics and dean of the School of Hygiene and Public Health at the Johns Hopkins University, has become editor of *Human Biology.* Since the death of Dr. Raymond Pearl the journal has been edited by Mrs. Pearl.

DR. A. H. SUTTON, of the department of geology and geography of the University of Illinois, has been granted leave of absence to become a geologist with the Aluminum Company of America in the Fluorspar District of Western Illinois and Western Kentucky. His address after June 1 will be Aluminum Ore Company, Rosiclare, Illinois.

DR. THORNE DEUEL, chief of the Illinois State Museum since 1938, left on May 22 on leave of absence to rejoin the United States Air Force, in which he served

during the first World War. He had resigned from the Air Force in 1919 with the rank of major.

DEVEREUX BUTCHER, staff photographer, artist and editorial assistant of the American Forestry Association, has been appointed executive secretary of the National Parks Association to succeed Edward B. Ballard, who has joined the Army.

THE Annual Symposium of the Society for the Study of Development and Growth will be held this summer at North Truro, Cape Cod, Mass., from August 24 to 28. Those wishing to attend should make reservations at the Whitman House, North Truro, as early as possible. A reservation fee of $1.00 is payable by non-members of the society. North Truro is readily reached by train and bus from both Boston and New York. Further information in regard to the society and symposium may be obtained from Dr. K. V. Thimann, secretary of the Harvard Biological Laboratories.

ONE alumni member, five members and seven associates were initiated by the Lehigh University Chapter of the Society of the Sigma Xi at the annual initiation and banquet on May 14. The retiring president, Bradford Willard, professor of geology, introduced Dr. Robert Cushman Murphy, of the American Museum of Natural History, who gave an illustrated address entitled "By Land and Sea in the Chocó." The officers for the coming year were announced: Allison W. Butts, professor of electrometallurgy, *President;* Lawrence Whitcomb, associate professor of geology; *Vice-president;* W. L. Jenkins, assistant professor of psychology, *Secretary;* E. H. Cutler, assistant professor of mathematics, *Treasurer.*

THE immediate establishment of a Scientific Advisory Council for the war effort has been officially announced in Jerusalem. The council will work in close cooperation with the Government of Palestine. Dr. Judah L. Magnes, president of the Hebrew University, has been appointed president, and Professor Farkas secretary of the council, the membership of which will consist of representatives of the Hebrew University, the Technical High School at Haifa, and the Agricultural and Daniel Sieff Institutes at Rehovot.

THE Institute of Aeronautical Sciences, New York City, has received a gift of $25,000 from Sherman M. Fairchild, aerial camera and aircraft manufacturer. The principal of the fund is to be used for the publication of technical material used by aeronautical engineers.

ACCORDING to the *Journal* of the American Medical Association the Association of Military Surgeons of the United States announces the competition for 1942 for the Sir Henry Wellcome Medal and cash prize of $500 for the best paper on "Measures of Preventive Medicine Recommended by the Federal Medical Services to Insure the Maximum Improvement of the Selectee of 1961 over him of 1941." The competition is open to all medical department officers of the Army, Navy, Public Health Service, organized militia, U. S. Veterans Administration, U. S. volunteers and those in the reserves, commissioned medical officers of foreign military services and all members of the association.

TWO prizes of $200 each, offered by A. Cressy Morrison, will be awarded at the annual dinner of the New York Academy of Sciences in December, 1942, for the two most acceptable papers in a field of science covered by the academy or by an affiliated society. Papers embodying the results of original research not previously published should be submitted, on or prior to November 1, to the executive secretary of the New York Academy of Sciences, the American Museum of Natural History, New York, N. Y.

THE Psychological Corporation offers for 1942–1943 James McKeen Cattell grants-in-aid of research in applied psychology. These grants are primarily available to graduate students and are of the value of $250. The closing date for the receipt of applications on forms provided by the Grants-in-Aid Secretary, is July 15, 1942. His address is The Psychological Corporation, 522 Fifth Avenue, New York, N. Y.

THE Westinghouse Electric and Manufacturing Company plant in Jersey City became the first New Jersey plant to win an "all-Navy E" pennant in recognition of continued excellence of production. The plant received an "E" flag last September.

A FIVE-DAY course on tropical medicine was given from May 25 to 29 by the department of medicine of the New York Post-Graduate Medical School of Columbia University, under the direction of Dr. Z. Bercovits. The purpose of this course was to bring to physicians a survey of the fundamentals of the various subjects in tropical medicine, and the more recent advances that have come from research. To this end, arrangements were made to have authorities in their respective fields give lectures and demonstrations in their specialties. Emphasis was placed on the clinical features. Clinical and laboratory material was available for study and demonstration, and the students were given an opportunity for practical work in clinical parasitology.

IN a basic research project recently established by the Navy Department, on problems relating to the operation of specialized aviation instruments, are the following members of the Mellon Institute of Indus-

trial Research of the University of Pittsburgh: Dr. George E. Barker, senior industrial fellow; George E. Alter, industrial fellow, and Charles E. McKnight, fellowship assistant. Other specialists will be added to the staff as the research progresses. A broad survey of the problems involved is being made by Dr. Barker, with the cooperation of the Navy Department, various American instrument manufacturers and other Federal Government laboratories.

WARD'S NATURAL SCIENCE ESTABLISHMENT, INC., which for over eighty years has been conducted in Rochester, N. Y., has moved to a new site on a sixty-five acre tract of land overlooking Irondequoit Bay and Lake Ontario, outside the Rochester city limits. Thirty-five acres are planted with grapes, the remainder being in woodland and pasture. Numerous springs furnish an abundant supply of pure water for cultures and other living material. The departments of mineralogy, paleontology, biology, entomology, and microscope slides and models are housed in a two-story concrete building, and the offices, mailing and photography departments in a large residence near the main building. There are seven other houses on the property and these will eventually be occupied by the Ward employees.

DR. C. P. RHOADS, author with Professor Louis F. Fieser and others of the article entitled "Steroid Hormone Excretion by Normal and Pathological Individuals," in the issue of SCIENCE for May 22, wishes to acknowledge the indebtedness of the authors to the Commonwealth Fund and to the Jane Coffin Childs Memorial Foundation for Medical Research.

DISCUSSION

IN DEFENSE OF THE KALLIKAK STUDY

THE story of the Kallikaks was published in 1912. The larger book, "Feeble-Mindedness: Its Causes and Consequences,"[1] giving the data which seemed to establish the hereditary character of feeble-mindedness, appeared in 1914.

For a decade the data were accepted apparently without question. There seems to have been enough people who were familiar with the details to explain how the study was made, the methods used, the conditions existent, and to answer any questions that arose. But as time went on, the inevitable happened and writers appeared who did not know, who obviously had not read the originals, and who therefore thought they detected certain flaws in the techniques which did not exist.

The first of these appeared in 1925 in "The Inheritance of Mental Disease," by Abraham Myerson, M.D. (pp. 77 *ff.*).[2] To this I paid no public attention because I felt that it was so obviously prejudiced that it would do no harm.

However, fourteen years later, a second book appeared which repeated and added to the errors of the Myerson book. This occurred in 1939 in "You and Heredity," by Amram Scheinfeld (pp. 360 *ff.*).[3]

Again in 1942 the same errors are copied from the preceding sources in "Biology for Better Living," by Ernest E. Bayles and R. Will Burnett (pp. 610 *ff.*).[4]

It therefore seems necessary to correct the errors publicly and attempt to set the record straight.

While much in the way of polish is lacking in this pioneer study, there are certain universal techniques which must be vigorously applied in any careful study; and to certain criticisms of these in Dr. Myerson's book, I wish to refer.

On page 77, Dr. Myerson, in a few lines, makes his only reference to "Feeble-Mindedness: Its Causes and Consequences"—the book which alone contains the data which led to the conclusion that feeble-mindedness is generally hereditary. The Kallikak family is merely a striking illustration.

Dr. Myerson says: "In this book, Goddard decides that feeble-mindedness is a Mendelian trait. He cites some 100 cases in which family studies have been made."

The record shows there are 327 cases carefully studied, charted and explained.

A few lines farther on, Dr. Myerson says: "The keystone of the arch of their results and laws is the field investigator and her surmises as to the mental and physical state of the dead and the quick."

Not understanding the purpose or the methods of the field-worker, Dr. Myerson makes his own assumptions. He argues that because he can not correctly diagnose feeble-mindedness, nobody can. Therefore, all our diagnoses must be guesses and "surmises."

The record shows that our field-workers were carefully trained (see "Feeble-Mindedness," pp. 22–46, 293 and 352). They spent weeks and months in the institution, talking with and observing all grades of defectives. It is well known that superintendents of such institutions quickly learn, and when a new arrival appears they not only know whether he is a fit subject for their institution or is normal and does not belong there, but they also know his *grade*. Even the attendants acquire this ability rather quickly. Dr. Fernald used to enjoy telling how his attendants

[1] Henry H. Goddard, "Feeble-Mindedness: Its Causes and Consequences." Macmillan. 1914.

[2] Abraham Myerson, "The Inheritance of Mental Disease." Williams and Wilkins. 1925.

[3] Amram Scheinfeld, "You and Heredity." Frederick A. Stokes Company. 1939.

[4] Ernest R. Bayles and R. Will Burnett, "Biology for Better Living." Silver Burdett Company. 1942.

would spot a child on the train and report that a new case was on the way.

But these are cases that were *seen*. How about cases in earlier generations, no longer living? Here again Dr. Myerson does not understand—although it is explained in the above references.

The field-worker does not make any "surmises," nor does she ask for anybody's "opinion." Such a method would be naïve indeed. She first asks the prospective informant: "Do you (or did you) know such a person?" If the answer is yes, she proceeds to ask many questions as to how he behaved, what he did, how he managed his affairs.

From this she gets an accurate picture of the kind of person he was. But she does not stop there. This informant may be prejudiced. His account must be corroborated. She hunts up everybody who knew the case. Finally she knows whether he was feeble-minded or normal. If she does not get enough information to decide without a reasonable doubt, the case is "undetermined," and is so marked. Dr. Myerson perhaps did not notice the many squares and circles that were not marked either "F" or "N." The figures are important. On the 327 charts there are 3,996 individuals marked normal (N), 1,946 marked feeble-minded (F): 476 doubtful (?): and 5,892 undetermined (left blank).

Moreover, we are not left without a check-up. After all the individual cases were finished and the charts made, we worked out the "expectation" according to the Mendelian principle, for five different kinds of matings; *e.g.*, if both parents were "F" all the children should be "F." We added all the children of such matings. The record shows 482 children whose status was determined. According to "expectation" they should all be "F." According to our determination, 476 were "F" and 6 were "N." Either we were in error to the extent of six cases, or there was some illegitimacy, or, as some biologists hold, two "F" parents may *rarely* have an "N" child.

The four other kinds of matings gave results equally close to the "expectation." This is all fully explained in "Feeble-Mindedness."

Dr. Myerson next turns his attention to the "Kallikak Family."[5] He ridicules the idea that we could know that the mother of the Kallikaks was feeble-minded, when we "did not even know her name," but had to put her down as "Nameless." I did not realize that it might mislead. All names are fictitious, and it occurred to me that "nameless" would identify her without any possibility of confusion. She is nameless to the reader only. We had her name; and not only her name but her history. We were fortunate enough to find an intelligent lady of advanced age, *who knew personally the "Nameless one."* That seems impossible until one realizes that if each of them had lived to be 80, they could have known each other for eight years or more; and if they had lived to be 90—not impossible—they could have been neighbors for 30 years! The nameless one was neither a prostitute nor a "bar-room habituée."

Perhaps Mr. Scheinfeld can explain how he acquired the information that "In 1898 Dr. H. H. Goddard, then director of an institution for mental defectives in New Jersey, chanced upon the strange fact, etc."

It is no misprint, because he repeats with emphasis on the next page "Remember, this study was begun in 1898, before there was any science of genetics."

The facts are these: I was never director of an institution for mental defectives and I did not begin the study of the Kallikaks in 1898. It was begun in 1910 and published in 1912.

Mr. Scheinfeld contributes one original idea—wrong like the rest. He says: "The comparison rests largely on *the assumption* (italics his) that the illegitimate child whom the feeble-minded mother chose to call Martin Kallikak, Jr., was indeed the son of the man she designated, which no court would accept as evidence."

A strange statement. Courts have always accepted such evidence and still do. In this case there was not even a doubt.

For the rest, Mr. Scheinfeld devotes a few paragraphs to prove the obvious.

Certainly Martin Kallikak, Sr., must have been a "Simplex," else his son by the "Nameless" would have been normal. But that is no argument. It is well known that a trait may remain recessive for generations as long as its possessors mate with "duplexes."

Finally we come to Bayles and Burnett. Their treatment of the matter is so much like Scheinfeld's that it has already been answered. With parrot-like accuracy they repeat Scheinfeld's error: "In 1898 Dr. H. H. Goddard began a study of two family lines that had a common ancestor," and on the next page, "Remember that the study was begun in 1898." They add, "Remember that Mendel's work was not known to the scientific world until 1900." And in the next paragraph, "Intelligence tests did not even exist when the study was made."

They are so sure of all this that they add "The persons in Goddard's study were classed as feeble-minded simply upon the basis of opinions of persons who had known them or who knew (however vaguely) of them." (Reminiscent of Dr. Myerson!)

The record shows that the Binet tests were extensively used by us in both studies. (See "Kallikak Family," pp. 71 and 88, also "Feeble-Mindedness," pp. 4 and 183, and see index.)

That these authors copied, uncritically, Scheinfeld's errors, including the absurd date, seems ob-

vious. Even a cursory reading of the "Kallikak Family"[5] or "Feeble-Mindedness" would have shown them that intelligence tests were in constant use.

Perhaps it is possible to regard these glaring errors as natural mistakes; but it is difficult not to feel that some, at least, result from wishful thinking.

In these days, one can not read everything. But if one feels it necessary to publicly criticize, it would seem that he should be sure that he understands what he is condemning. This would be not only for his own protection, but for the far more important consideration, the preservation of truth and the advancement of science.

HENRY H. GODDARD
THE OHIO STATE UNIVERSITY

THE GRAYING OF HAIR

DR. ALEŠ HRDLIČKA'S[1] recently publicized explanation that as one of the functions of the hair is to excrete melanin, graying of the hair is, therefore, a quantitative expression of the total amount of melanin to be excreted by the body, which in some way, not explained, depends on the metabolism. Thus, according to Dr. Hrdlička, graying is an automatic expression of the dying fires of metabolism, and no drug or chemical can be expected to have more than a temporary effect.

The color pattern of the hair is not only generally, but also somatically inherited. If this were not so we might be startled to find our leopard losing her spots and the tiger his stripes. Moreover, we would be at a complete loss to explain the white tips on black fox fur or the reverse on ermine.

That the coloring of the hair is functional in character and not automatically dependent on some generalized bodily change or growth is most clearly shown by the fact that certain animals, as the Arctic fox, change the entire color of the hair from winter to summer season, which is coupled with the moulting function; also shown in birds, like the ptarmigan. Moreover, in birds, and to some extent in mammals, the pattern of the hair coloring changes with sex activities, remarkably confirmable by experiment. In humans, both the hair coloring and its time-duration is a hereditary matter and independent of general health, virility or age.

Moreover, much evidence goes to show that melanin formation is a local matter. Commonly, for example, one finds the scalp hair white over the site of a former injury, although there is a good hair growth continuing. This is also true in other pigmented tissues, such as the skin. Pregnancy, lice, irritation, etc., cause marked localized pigmentary changes. On the other hand, as yet unknown factors cause marked patch withdrawal of pigmentation (Vitiligo) peculiarly striking in colored people. The Negro's hair grays with age; his skin doesn't, which fact I find impossible to coordinate with Dr. Hrdlička's idea of general melanin excretion.

While sex seems to play an important role in hair coloring, nevertheless, albinos breed quite freely, as laboratory rats and mice amply demonstrate.

That the matter is not a simple concomitant of growth or nutrition is well illustrated by the fact that the "bald" area rarely becomes markedly gray primarily, and often completes its own peculiar function without any graying whatever. The lateral margins of the scalp, on the other hand, most commonly gray first and they, on the contrary, rarely become bald.

All the above facts are but a small selection of the large number illustrating the same matter; namely, that while there are many outside controls reacting on the actual machinery of pigmentation, nevertheless, this is a separate entity. Moreover, each cell shows a quantitative difference in its reactivity to such controls so that hairs growing side by side may show very marked pigmentary contrasts. Such facts leave little doubt that the fiber pigmentation is a special function, and unless this be a solitary exception to the general rules of physiology, it is capable of being altered in a quantitative manner by pharmacological agents.

DR. OWEN S. GIBBS,
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SOME FACTORS AFFECTING APPLE SCALD DISEASE

THE scald disease of the apple is a storage disorder which causes tremendous wastage in storage wherever apples are stored the world around. The cause of this disease was found by workers in the U. S. Department of Agriculture to be accumulations of certain volatiles around the fruit in storage.[1] They devised a method of control in which these volatiles were absorbed by paper wraps impregnated with mineral oil.

Two years' results on the Rhode Island Greening variety indicate that coating the fruit with a wax emulsion (Brytene 489 AM) gave considerable promise in scald control. On prematurely picked apples, the wax treatment did not give as good control as the oiled paper treatment, but on pickings made at the normal time it gave as good control as oiled paper. Waxing has the advantage over the oiled paper treatment in that it keeps the fruit in a more green, crisp

[5] Henry H. Goddard, "The Kallikak Family." Macmillan. 1912.

[1] *Jour. Am. Med. Asn.*, March 14, 1942, p. 918.

[1] C. Brooks, J. S. Cooley and D. F. Fisher, *Jour. Agr. Res.*, 18: 211–240, 1919.

condition. It is suggested that small commercial trials of this wax treatment be made. A concentration of 6 to 8 per cent. solids in the emulsion is suggested.

It was found that the volatiles from one lot of apples may induce scald on a second lot. Susceptible varieties scald much sooner and more severely in the presence of volatiles from McIntosh apples than when stored alone. This was true both in ordinary cold storage practice and in "controlled atmosphere storage," where carbon dioxide and oxygen levels as well as temperature and humidity were controlled.

Progress has been made in "air conditioning" the storage atmosphere to rid it of these harmful volatiles, but absolute scald control by this method has not yet been attained. The more promising materials which have been used in the air-conditioning process have been various oils and activated charcoal. Failure to attain complete control of the disease by this method may be attributed partially to a lack of knowledge as to when the absorbing materials became saturated.

R. M. SMOCK
F. W. SOUTHWICK

DEPARTMENT OF POMOLOGY,
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A GRASSHOPPER PROBLEM IN MECHANICS

A FRIEND on a farm, having to move a hive full of bees, asked me whether the hive would weigh less if the bees were stirred up so as to fly around inside the closed hive while she carried it. This suggested a similar—but mathematically simpler—problem: Will a suitcase containing a pound of grasshoppers weigh less if the grasshoppers are jumping so that half of them are constantly in the air in the suitcase than if all are constantly at rest?

If a grasshopper of mass m jumps with a vertical velocity v, the downward impulse on the suitcase is mv when he jumps and also when he alights, which will be $2v/g$ seconds later if he strikes nothing; therefore if n grasshoppers are in the air half the time, the average downward impulsive force due to the change in momentum is one half of $2nmv$ divided by $2v/g$, that is $\frac{1}{2}nmg$; and this added to the weight of those at rest gives the dead weight of all. In other words, the total average weight is the same whether they are jumping or not. This is, of course, the kinetic theory explanation of the downward pressure exerted by the weight of a gas. It should be noted, however, that only the average weight is the same. If a box containing a single grasshopper is suspended from a sensitive spring balance, every time he jumps the box will receive a downward kick. So the indicated weight of any body not at absolute zero is partly static and partly kinetic, and is a statistical average sum of varying static and impulsive forces.

The hive-and-bees problem is more complex; but in this case also, of course, the total average weight must be the same no matter what the actions or motions of the bees and other parts inside the closed container may be.

This problem is doubtless very old, though I do not happen to have run across it before. References to previous discussions of it will be appreciated.

GORDON S. FULCHER

WASHINGTON, D. C.

SCIENTIFIC BOOKS

EPILEPSY

Epilepsy and Cerebral Localization. By WILDER PENFIELD and THEODORE C. ERICKSON. 607 pp. Springfield, Illinois: Charles C Thomas. 1941.

A RARE kind of devotion to suffering humanity and science is needed to keep a man working at a disease such as epilepsy. The patients are deeply distressed and distressing to the physician because many can not be given much aid. Lennox in his recent book, "Science and Seizures," has shown this spirit and has written a book from the medical and social view-point. Now comes "Epilepsy and Cerebral Localization," by Penfield and Erickson, from the surgeon's point of view. But these men are more than surgeons; they have approached the entity called "epilepsy" from the physiological standpoint; they have made histological studies and finally, with the aid of the special laboratories of Dr. Jasper and Mrs. Erickson, respectively, they have taken up electroencephalography and psychology, as related to epilepsy.

A series of proven cases of focal epilepsy treated by craniotomy provided the major source of material for physiological, psychological and anatomical studies of the human cerebral cortex over a ten-year period. The histology of cerebral scars, the cytology of the brain, the structure and control of cerebral vessels and the physiology of cerebral blood flow have formed the subjects of what might be called their preliminary research. During the process of clinical elaboration, collateral studies were made upon patients suffering from all types of convulsive states by electroencephalography and pneumoencephalography as well as by the analysis of seizure pattern and clinical picture. At the same time related medical literature has been freely used. For students of neurophysiology the direct observations made upon the cerebral cortex of conscious patients and the descriptions of patterns

of epileptic discharge provide valuable material. The chapter on cranial roentgenography treats chiefly the atrophic lesions of the brain and skull. Because of the fact that war came upon the world before the completion of the manuscript, Chapter XIX on acute head injuries has been added. The treatment of atrophic cerebral lesions and of brain tumors is described in practical detail. An exhaustive report is made of the results of operations (Chapter X). Over a ten-year period 165 operations were performed for the removal of cerebral or meningocerebral scars. Thirty-four of these proved to be "negative explorations"; in 62 there was removal of a meningocerebral cicatrice; in 53 the cicatrix was cerebral only. Since operation 22 per cent. of the former and 19 per cent. of the latter patients have been entirely free from attacks. An additional 54 per cent. of the patients with meningocerebral scars were conspicuously improved, the corresponding figure for purely cerebral scars being 40 per cent. Only 11 per cent. of the former and 3 per cent. of the latter showed no improvement at all. In short, these operations are well worth doing and if the scar involves both meninges and brain, there is a nine to one chance of clinical improvement and a one to four chance of cure, with an operative mortality of 4 per cent. Moreover, the improved techniques of pneumoencephalography are a great aid in determining which cases should be explored surgically. For example, many brain tumors are found, some of them removable. The results from removal of encapsulated tumors are about 20 per cent. cured of seizures and 40 per cent. conspicuously improved; infiltrating tumors only do about half as well.

The chapters on "Seizure Patterns" and "Mechanism of Epileptic Seizures" bring much important data to the physiologist who is interested in the function of the human brain. The authors define epilepsy as the tendency to recurring epileptic seizures. "An epileptic seizure is a state produced by an abnormal excessive neuronal discharge within the central nervous system. An epileptic seizure is therefore a symptom of disease, but epilepsy itself should not, strictly speaking, be used as a name for that disease." Seizures have one common feature: a direct influence upon the central nervous system, which results in recurring explosive neuronal discharges. On pathological grounds, they differ widely. Anatomically, the part of the central nervous system wherein the neuronal discharge occurs may vary greatly, but there is a common physiological mechanism which produces the outward manifestations of a seizure.

From a practical point of view, in the consideration of many of the epilepsies, the cause is readily recognized, *e.g.,* cases of brain tumor, traumatic scar of the cerebral cortex and hypoglycemia. Such types have been called *symptomatic epilepsy.* But after one names the long list of pathological lesions that may affect the brain and after the obvious extra-cerebral causes are enumerated there remains a residue, an all-too-numerous group of cases in which the cause can not at present be found. To these patients the term *cryptogenic epilepsy* (of obscure origin) has been applied. This group will contain a large number of cases in which there is a strong familial tendency and in which the electroencephalographic record has a characteristic form, the spike and slow wave described by Gibbs, Gibbs and Lennox. Many of these cases will be found to fall into the clinical classification of "petit mal."

The careful clinical research for focal symptoms; the operations under local anesthesia and the refined exploration of the cortex in conscious patients have brought in a wealth of important material. The clinical descriptions of various seizures and their classification in relation to localization and electroencephalography is also a distinct advance. The medical profession has been too willing to put the attacks into three vague and loosely defined categories: "grand mal," "petit mal" and "psychomotor attack." As generally used, these terms are meaningless from the physiological standpoint and inadequate clinically. If used accurately in their classical sense, they would not cover the field at all. Penfield brings this out in his clinical analysis and Jasper substantiates the neurological observations with the electroencephalogram (Chapter XIV). Jasper makes four salient points:

(1) Epilepsy, as viewed by electroencephalography, consists of recurring paroxysmal high voltage waves, electrical signs of excessive synchronized neuronal discharge or *hypersynchrony.* Often, but not always, there are associated abnormal rates of cerebral discharge or dysrhythmia, tachyrhythmia or bradyrhythmia.

(2) The epilepsies may be divided into three principal groups with regard to localization of abnormal waves: (a) *localized* to a specific cortical area of one hemisphere, (b) *bilaterally synchronous* from homologous areas of the two hemispheres, and (c) *diffuse* wide-spread disorganized abnormal waves often with generalized cerebral tachyrhythmia or bradyrhythmia.

(3) The form of local cortical epileptic discharge recorded near its source is the same from any superficial cortical area while the form of clinical seizure depends upon the function of cortical area of onset and path of march.

(4) There is a close correspondence between cortical localization by the E.E.G. and the localization arrived at by analysis of the nature of onset of the clinical seizure.

The book is obviously written from a wide experience in surgical cases, but the authors have also seen in their clinic and practice a large number of epileptics of the cryptogenic type and they have two chapters on these more medical aspects (XI and XII).

The inheritance of epilepsy is discussed and the data are well presented, but it seems to me that the obvious conclusion is not drawn, *i.e.*, that "idiopathic epilepsy" is identical with "inherited epilepsy," and that all other cases have cerebral lesions. Of course there is always the group of "cause unknown" ("cryptogenic," if you prefer Greek) because the doctor lacks diagnostic means. At any rate I feel that the time has come to drop the term "idiopathic."

Under "extracerebral causes" are discussed various systemic variants of circulation, water metabolism, etc., which effect fits. The authors clearly state that epilepsy is cerebral and that these are really precipitating causes, if causes at all. Nevertheless, some are important in treatment.

In a disease where the most important symptom is clouding of consciousness or loss of it, the subject of "consciousness" must come up for discussion. At the end of Chapter VI, on "Functional Levels in the Central Nervous System," the highest level is considered "the level of consciousness" and four pages are given to a discussion which I consider the weakest part of the book. I can not believe that consciousness is a one-level affair and I do not agree that there is an area of "highest level of integration," the integrity of which is essential to consciousness. That such a "level of final integration" lies within the diencephalon seems most improbable. The epileptologist certainly knows a lot about *un*consciousness, but he is taking chances when he lightly discusses consciousness in a few pages without careful definition of what he means. It remains the great mystery.

This book contains little about the end results of epilepsy seen in institutions; it does not discuss many of the problems that arise in large epileptic hospitals. From that point of view the book is not a treatise on the care of the epileptic. The authors are not distracted by the older clinical writings which look on epilepsy as a "disease" that "leads to deterioration." They start physiologically and hold to their physiology, applying it to clinical phenomena. Therefore, and because of its scope and data, I think this is the best book ever written on epilepsy.

STANLEY COBB

SOCIETIES AND MEETINGS

THE EIGHTH ANNUAL WASHINGTON CONFERENCE OF THEORETICAL PHYSICS

THE topic of the Eighth Annual Washington Conference of Theoretical Physics, held on April 23, 24 and 25 in Washington, D. C., at the George Washington University, under the joint auspices of the Carnegie Institution of Washington and the George Washington University, was "The Problems of Stellar Evolution and Cosmology."

This topic represents essentially the further development of discussions at the Fourth Conference of May, 1938, on "Problems of Stellar Energy-Sources." During the four years since that conference, many problems pertaining to the process of energy-production in stars became completely clarified and present now a solid basis for further advances in this field. There seems hardly any doubt that the so-called "carbon cycle," first proposed by Dr. H. Bethe at the Fourth Conference, actually represents the source of energy for our sun and for all other stars of the "main sequence." It is also becoming more and more certain that the energy-source of the so-called "red-giant stars" lies in the thermonuclear reactions of the three light elements, lithium, beryllium and boron, as was proposed by Dr. G. Gamow and Dr. E. Teller.

But, whereas we know the particular nuclear reactions which are responsible for the energy-production in various types of stars, the problem of stellar evolution, that is, changes with time of the observable characteristics of a star particularly in its application to the "red giants," still presents serious difficulties. Because of the absence of any appreciable convection-currents through the entire body of the star, it seems that the nuclear transformation of various chemical elements in the star should take place in a spherical shell, the radius of which is steadily increasing in the process of evolution. This necessitates the study of the so-called "shell-model" of a star as first proposed by Gamow during the Fourth Conference. Study of this model was considerably advanced during the last year by Dr. S. Chandrasekhar and Dr. M. Schoenberg, who reported their results at the first session of the Eighth Conference.

It was shown by Chandrasekhar that the growth of the "shell" does not extend all the way to the surface of the star but stops when the shell envelops 35 per cent. of the total mass of the star. When the shell, for example, corresponding to the transformation of lithium, has reached its maximum extent, the star undergoes a rapid process of gravitational contraction and the new shell corresponding to the next element (beryllium in this case) starts to grow from the center.

Schoenberg has investigated a special case (of particular interest for the sun and the stars of the main sequence) where the molecular weight of the stellar matter changes as the result of the nuclear transformations in the growing shell. His calculations lead to the interesting conclusion that, at the end of its hydrogen-evolution, our sun will increase in luminosity only by a factor of three and not by a factor of one

hundred, as was previously concluded from the old homogeneous model.

Considerable discussion followed Schoenberg's statement that in the process of shell-growth, the potential energy of the star reaches a minimum, and that the star may become unstable at this particular point of its evolution and be subject to periodic pulsations of the Cepheid-variable type. It was indicated by Teller that, according to Cowling's theory of stellar stability, pulsations of the type proposed by Schoenberg should not be expected.

On the question of the "mixing-up" process in a stellar interior, Dr. G. Randers reported his calculations of the convection-processes in rotating stars. His conclusion is that the so-called "Eddington convection currents" are balanced by the more rapid rotation of the stellar equatorial regions and hence no exchange of material between the deep interior of the star and its surface should be expected.

Following the reports on the "shell-model" the discussion shifted to the problem of the correlation of various theoretical viewpoints on stellar evolution and the observational facts on the relative abundance of stars of various types. Dr. H. Shapley gave a general survey of the observational evidence and stressed the point that the familiar pattern of the Russell diagram is essentially based on the study of one particular part of our stellar system (a large-scale region surrounding the sun) which should not be considered as a fair sample of the entire stellar universe. Indeed, it has been found that the relative number of various star-types is quite different for the central and outer regions of the galaxies; quite different results are also obtained in globular and irregular stellar clusters. Thus, in any attempt to correlate the theoretical picture of stellar evolution with the observational material, one must necessarily take into account this general stellar population in various parts of the universe.

The second important problem of the conference (mostly during the session on April 24) was that of the expanding universe and the related question of the origin of chemical elements during the early stages of the expansion. It should be noted that there is still considerable disagreement among investigators as to whether our universe is an expanding one. In a recent publication Dr. E. Hubble, interpreting the observed red-shift as due to Doppler-effect of receding nebulae, arrives at a conclusion not in accordance with geological evidence. Thus his calculated age of the universe is only about one billion years, that is, considerably shorter than the geologically estimated age of the earth. However, Gamow indicated that Hubble's result is based on the distance-scale obtained by assuming that the intrinsic luminosity of nebulae remains constant even if their ages differ by hundreds of millions of years. The above-mentioned discrepancy is easily explained by assuming that the luminosity of nebulae may decrease during such long periods of time by a few per cent. A decrease of this order might well be expected because of changes during stellar evolution and the escape ("evaporation") of stars from separate nebulae. Thus the solution of the problem of the expanding universe must await more information regarding the evolutionary history of separate nebulae.

The other angle of the problem was discussed by Dr. L. H. Thomas, who reported his attempt to explain the red-shifts in the spectra of distant light-sources as resulting from the interaction of the traveling light-quanta with the free electrons in interstellar space. His calculations were entirely on the basis of classical electrodynamics, but there is still the question whether his result will hold in quantum-mechanical treatment.

It is, however, desirable to retain the hypothesis of the expanding universe, since it provides a basis by which a great many phenomena may be explained. The most important of these is the riddle of the origin of chemical elements—a process requiring high temperatures and densities such as could have existed only in the early stages of an expanding universe. It may be easily shown that under the most extreme conditions now existing in the interior of various stars, only the lightest elements of the periodic system could be transformed from one to the other. To explain the presence and the observed relative abundance of all heavier elements—in particular the existence of uranium, thorium, etc.—one must necessarily assume that two or three billion years ago the density of matter in space exceeded ten million times that of water and the temperature was as great as several billion degrees. These are just the conditions corresponding to the early stages of the expanding universe.

The attempts to explain the observed relative abundance of various chemical elements have been hitherto followed in two different directions: (1) That the present abundance arises from some kind of chemical equilibrium between various nuclei at certain high temperature and density; (2) that the origin of elements is a breaking-up process similar to the recently discovered process of uranium-fission. Both points of view were discussed during the second session of the conference and it was agreed that the second point of view is the more probable. In his report on the "equilibrium-theory" Chandrasekhar indicated that the observed abundance of the elements from oxygen to argon may be well represented by an equilibrium-state corresponding to a temperature of 8×10^9 °C and density of 10^7. On the other hand, the abundance of heavier elements calculated under these assumptions decreases much too rapidly; thus the computed

abundance of the elements at the end of the periodic table is 10^{10} times smaller than the observed values. Empirically, the abundance-curves run almost horizontally, beginning at the middle of the periodic system which, as it is easy to see, can not correspond to any state of chemical equilibrium.

Discussion centered mainly around the possibility that the heavy elements originated at still higher temperature and density and that their relative proportions were later "frozen up" in the process of expansion. This discussion led to the conclusion that the "freezing up" process could hardly take place since, in the presence of free neutrons, heavy elements would be transformed into light ones (through the "neutron-evaporation"), even at much lower temperatures. It seems, therefore, more plausible that the elements originated in a process of explosive character, which took place at the "beginning of time" and resulted in the present expansion of the universe. Some details of such breaking-up process of the heavy fragments of primary nuclear matter which would finally lead to the ordinary nuclei of the known stable elements were discussed by Teller.

The third day of the conference was devoted to fundamental problems of physical constants and the properties of elementary particles. Teller presented his criticism of Dirac's recent view that the number of elementary particles in the universe and also the value of the gravitational constant are slowly changing with time. He indicated that, assuming Dirac's hypothesis, one would expect large changes in the luminosity of the sun, which is contrary to geological evidence.

Thomas presented his recent attempt to build up a formalism for consistent quantization of the electromagnetic field which would eliminate the difficulties inherent in the infinite self-energy of elementary particles.

Dr. W. Pauli discussed the theory of the "meson" on the assumption of zero-spin and concluded that this assumption is not very satisfactory.

Twenty-six investigators from 15 universities and research organizations took part in the conference. These were: British Central Scientific Office (Greenwich Observatory), R. d'E. Atkinson; Carnegie Institution of Washington, J. A. Fleming; Catholic University of America, K. F. Herzfeld; University of Chicago (Yerkes Observatory), S. Chandrasekhar, G. Randers and M. Schoenberg; Columbia University, W. E. Lamb, A. Nordsieck, F. Perrin and S. Rosenblum; Harvard University, C. L. Critchfield and H. Shapley; Institute for Advanced Study, W. Pauli; the Johns Hopkins University, D. R. Inglis; Ohio State University, L. H. Thomas; Princeton University, S. Rosseland; National Bureau of Standards, G. Chertog; Navy Department, Bureau of Ships, R. Richtmyer; Naval Ordnance Laboratory, T. Page; Naval Research Laboratory, R. Gunn; George Washington University, H. V. Argo, Th. B. Brown, G. Gamow, Miss M. F. Langs, R. J. Seeger and E. Teller. Several leading nuclear physicists and astronomers from various parts of the country who had also accepted invitation to take part in the conference could not do so because of urgent unexpected demands of their national-defense problems.

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REPORTS

THE FIRST ANNUAL REPORT OF THE CHAIRMAN OF THE NATIONAL SCIENCE FUND

LAST year when the Board of Directors[1] of the National Science Fund met to complete the organization of the National Science Fund, our country was still at peace. On December 7, 1941, midway in the first year's development program, it was necessary to stop and reconsider the aims of the fund and to determine whether under war conditions the National Science Fund could and should continue. The Executive Committee concluded that although the National Science Fund may not stand in the full current of military progress, war makes it imperative to put forth our greatest efforts to assure continued adequate support for basic research in science. Even though fundamental research should fail to produce a single discovery applicable to the war, it still would be essential to the future peace. Vice-president Henry A. Wallace has made it clear that he understands how important it is for us to face these realities: "From the practical standpoint of putting first things first, at a time when there are not enough hours in a day and every minute counts, planning for the future

[1] The Board of Directors for the year 1942–43 is composed of the following: *Chairman:* William J. Robbins; *Vice Chairman:* Winthrop W. Aldrich; Roger Adams, James R. Angell, James F. Bell, Albert F. Blakeslee, Isaiah Bowman, Arthur H. Compton, James B. Conant, Edwin G. Conklin, John W. Davis, Luther P. Eisenhart, Homer L. Ferguson, Herbert S. Gasser, Walter S. Gifford, Ross G. Harrison, Carlton J. H. Hayes, Herbert Hoover, Jerome C. Hunsaker (Treasurer), Frank B. Jewett, Ernest O. Lawrence, Frank R. Lillie, Archibald MacLeish, Robert A. Millikan, Harvey S. Mudd, Alfred N. Richards, Elihu Root, Jr., Harlow Shapley, Tom K. Smith, Lewis L. Strauss, Harold H. Swift, George H. Whipple.

peace must of necessity be a part of our all-out war program." To preserve and advance our democratic civilization after the war is over will demand full use of basic discoveries made by research scientists during these war years. It is not putting the matter too strongly to say that the basis for any lasting peace when this war is over may well be founded on some discovery made by research in fundamental science.

The National Science Fund's major aim is to cooperate in making it possible for this research to go on. By securing the understanding and enlisting the support of the public, new private funds can be put to work to supplement the research budgets of university and other privately endowed laboratories, where the crippling blows of shrinking investment income and reduced tuition have compelled curtailment or cessation of important researches. War brings home to the American people the importance of applications of science. Many now understand that mathematicians apply modern theory of probability to the strategy and tactics of aerial fighting and to improving the accuracy of gunfire; that psychologists and botanists contribute to camouflage; that physiologists study war-time diet and drugs. Pearl Harbor has already shown us what the sulfonamide drugs can do to reduce the toll of war injuries. A physiologist tells us that his research indicates that the successful solution of several problems in aviation medicine may contribute materially to the outcome of the war.

These applications of science are understandable to most people, but too many fail to realize that we can not make American science fully productive unless we can maintain fundamental research, and enable those scientists who stand outside the direct scope of the government's war research program to carry on their important work. In the National Science Fund, a potentially powerful means of advancing human welfare through science is already in existence. It is truly dedicated to the service of all humanity and all science, and not to the individual interests of any one sector or to any individual institution. It is prepared to receive and administer funds for the advancement of science under an organization which guarantees so far as is humanly possible that any money entrusted to it will be safeguarded as to principal and income and invested to the greatest advantage in science. It is further prepared to act as a clearinghouse for questions from prospective donors on the support of science or from scientists who need financial assistance for their researches. The National Science Fund offers the possibility of serving donors who have funds they wish devoted to science, of serving science by increasing its support and of serving all humanity through the advancement of science.

The chief concern of the National Science Fund in its first year's activity has been to contribute toward a greater general understanding of the value of fundamental science, the necessity for its support and the fact that the National Science Fund has a unique machinery for this financing. A public relations program was first directed to scientists and scientific workers because it was felt that their wholehearted understanding and support was essential for the long-term successful development of such a fund. An 8-page brochure entitled "Philanthropy in Science"[1] was widely distributed. Through the cooperation of Dr. Langmuir, president of the American Association for the Advancement of Science, the fund was presented to each of the 15 sections and to the 179 societies affiliated with the association. Representatives described the fund before many of the major scientific meeting and notes, articles or editorials appeared in numerous periodicals read by scientists. A series of four radio programs was presented over a national network. Effort is now being directed to professional groups of laymen and to the general public.

In anticipation of enlisting public interest and support two surveys were made with the help of leading scientists to determine current critical areas of scientific research. The results of these surveys, which are of considerable interest, will be published.[2] In addition a partial review of the grants-in-aid made by the National Academy of Sciences over the past twenty years from its trust funds was made. Under the auspices of the National Science Fund a detailed and documented study of the relation of fundamental research to practical applications has been initiated by a student of the history of science which will illustrate the vital interest the general public has in fundamental science—and in its adequate support.

Although the National Science Fund during its first year of operation has had no funds for direct appropriation more than 50 requests for financing research have been received. These have been carefully reviewed and where circumstances warranted the applicant was put in touch with potential sources of funds. In several instances assistance was made available. The National Science Fund has also acted as a consultant on several projects which bear directly or indirectly on the war effort. In thus acting as a clearinghouse the fund appears to be performing a function not otherwise adequately met. It is hoped that as time passes there will be more prospective donors who will ask the National Science Fund to locate qualified scientists whose research they could support or to point out areas for research where money could be wisely used for the public good.

[1] R. E. ... *our. M...*

[2] F. D... 73, 194...

SPECIAL ARTICLES

THE PRODUCTION OF PERMANENT HYPERGLYCEMIA AND GLYCOSURIA BY THE PROLONGED ADMINISTRATION OF INSULIN

IT is apparent from the studies of Haist, Campbell and Best[1] and of Lukens and Dohan[2] that insulin, fasting or fat-feeding rests the islands of Langerhans, and that the procedures which permit the islets to rest also prevent or hinder the development of the diabetic state which results from the administration of anterior pituitary extracts to dogs. Accordingly, Haist, Campbell and Best recommended that the procedures established as beneficial for animals should be tried in man as a prophylactic measure for the prevention of diabetes, especially in the case of children with a diabetic family history.

However, since the administration of exogenous insulin can reduce the insulin content of the normal pancreas, it is possible also that it may depress completely the production of insulin and thereby induce permanent diabetes in a patient with a relative deficiency. In order to put this possibility to test, from 30 to 75 per cent. of the pancreas was removed from dogs. Since such animals can become diabetic only if hyperglycemia is induced by the administration either of large amounts of carbohydrate or of anterior pituitary extracts, they may be regarded as being very susceptible to diabetes, but not as having diabetes. Such a situation may exist in the patient who eventually becomes diabetic.

After the immediate post-operative effects were over, the animals were treated with protamine zinc insulin to the limits of their capacity and were permitted to eat freely. The blood sugar level was studied carefully to maintain a constant hypoglycemia. In three animals that were studied for over one year, it was noted that hyperglycemia and glycosuria appeared in from 20 to 40 weeks after the beginning of the protamine zinc insulin treatment. Furthermore, these animals apparently developed a permanent diabetes since the hyperglycemia and glycosuria persisted for as long as 30 weeks thereafter.

Fig. 1 illustrates the history of a dog from which a maximum of 66 per cent. of the pancreas was removed and which, after several days, was started on daily injections of protamine zinc insulin, the dosage being increased to the limits of the animal's capacity to withstand hypoglycemia. The animal was permitted to eat freely and what remained was measured. It was noted that the blood sugar did not reach hyperglycemic values even when, in the 18th week, insulin was stopped for several days. Up until the 22nd week the animal's weight rose gradually and then a precipitous fall occurred. Thereafter, the animal exhibited all signs and symptoms of pancreatic diabetes with hyperglycemia, glycosuria and ketosis, the latter being apparent after insulin deprivation. With the administration of adequate amounts of insulin for the remaining 30 weeks of the study, the animal could be rendered aglycosuric. The degree of glycosuria was definitely related to the amount of carbohydrate ingested. Insulin was removed on the 54th week and the animal died in a cachectic state 11 days later.

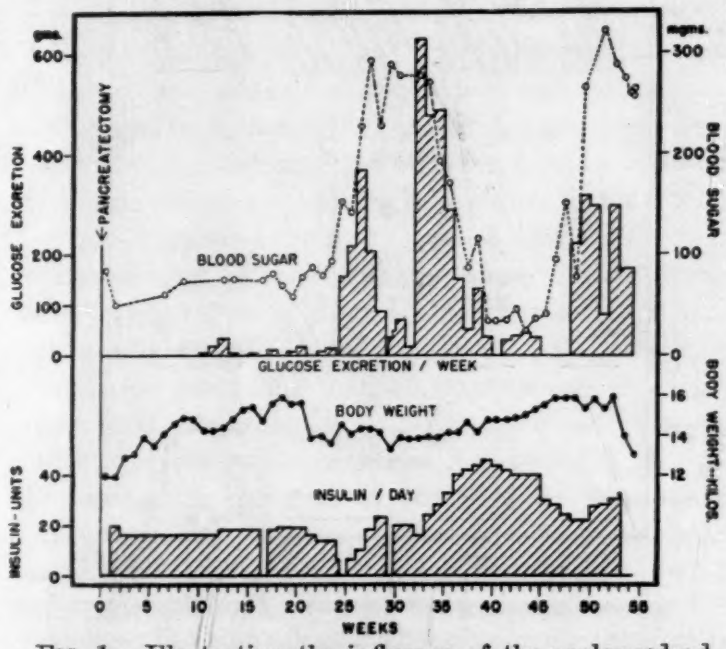

FIG. 1. Illustrating the influence of the prolonged administration of protamine zinc insulin to a partially depancreatized dog. The blood sugar values are the highest obtained during the week.

Autopsy revealed 4 grams of pancreas which did not appear abnormal on gross examination. Repeated sections made from numerous blocks of this tissue revealed no normal islet tissue. Only a rare area was found suggesting an islet of Langerhans that apparently was undergoing involution. These few islets were small, inconspicuous and showed changes suggestive of fibrosis.

In order to illustrate further the fact that the diabetes which was produced in consequence of the prolonged administration of protamine zinc insulin was essentially indistinguishable from that which results from total pancreatectomy, various periods during which insulin was stopped in the dog are depicted in Fig. 2. During the first and 18th weeks after operation, the removal of exogenous insulin did not result in glycosuria or hyperglycemia. However, during the 25th week glycosuria became apparent after exogenous insulin deprivation, and hyperglycemia more so thereafter.

These studies are in accord with the observations

[1] R. E. Haist, J. Campbell and C. H. Best, *New England Jour. Med.*, 223: 607, 1940.

[2] F. D. W. Lukens and F. C. Dohan, *Endocrinology*, 30: 775, 1942.

that insulin administration results in a decrease in the production of insulin by the islet tissue.[1,2] However, it is apparent that the prolonged use of protamine zinc insulin accentuates this phenomenon to such a degree that a "disuse atrophy" of the pancreas ensues.

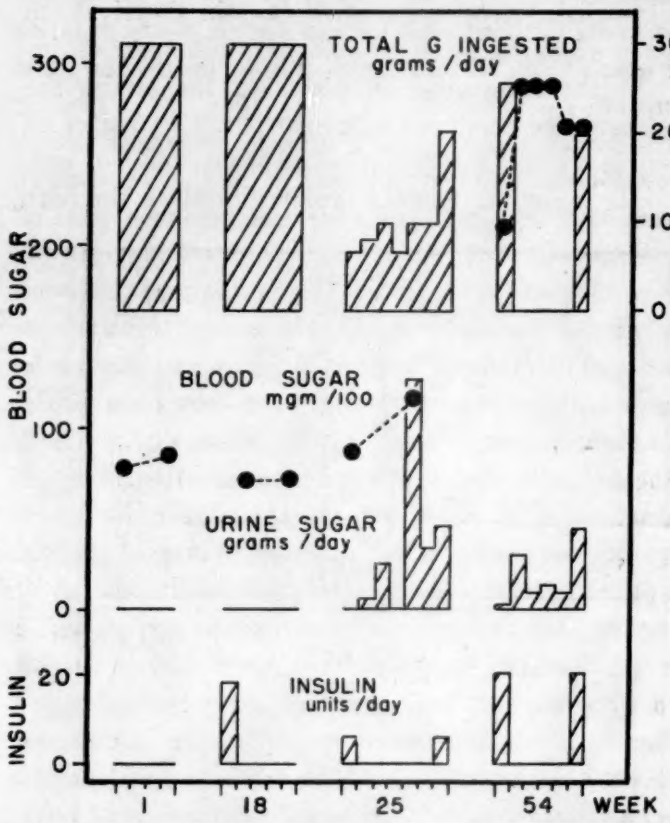

FIG. 2. Illustrating the influence of insulin deprivation at various intervals after the administration of protamine zinc insulin to a partially depancreatized dog.

This compensatory decrease in insulin secretion and its morphological counterpart is made more evident in these experiments, where the amount of pancreas present in the animal is relatively small, though adequate for normal maintenance. It is suggested, therefore, that it might be an extremely dangerous practice to utilize protamine zinc insulin as a prophylactic measure in man, in contrast to its beneficial influence in diabetes mellitus.

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ON CATARACT AND CERTAIN OTHER MANIFESTATIONS OF TRYPTOPHANE DEFICIENCY IN RATS[1]

IT is recognized that tryptophane deficiency leads to lesions in the eyes. Curtis, Hauge and Kraybill[2] in 1932 and Totter and Day[3] in 1941 reported the occurrence of cataract in tryptophane deficient rats, and the latter observers also noted vascularization of the cornea in this condition. We can amply confirm and extend these observations, and we have furthermore noted lesions characteristic of tryptophane deficiency in other organs.

TRYPTOPHANE CATARACTS

In our experiments a tryptophane deficient diet[4] similar to that employed by Totter and Day[3] (No. 5000) was employed. Young rats of about 100 grams in weight, when placed on this diet, developed cataracts with great regularity in from seven to eleven weeks, in contrast to paired feeding control animals on analogous diets containing tryptophane. Two different types of cataract have been observed in the tryptophane deficient animals—an *acute* and a *chronic* type.

The *acute type* starts in the posterior cortex of the lens, spreading within a few days to the perinuclear, nuclear and anterior cortical zones and maturing within two to three weeks. Within a week after the maturation of the cataract the animals die. The acute form of cataract can be arrested in its early stages by supplementing the diet with tryptophane, but some opacities still develop for a time after the supplement is instituted.

The *chronic type* of cataract is confined to the anterior and posterior cortex of the lens and does not mature within the life-time of the animals, which varies from four to nine weeks after the onset of the cataract. In one animal we have observed a combination of the morphological features of both types of cataract. We do not know what factors determine the type of cataract which develops, but our results suggest that the strain of rats studied may be important.

We have observed cataracts *only in growing animals*

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[3] Leo Lehman fellow.

[1] This study was supported in part by grants for the study of amino acids in nutrition made by the Rockefeller Foundation, Merck and Company, Eli Lilly and Company and E. R. Squibb and Sons. This material was presented in part at a demonstration at the meeting of the Federation of American Societies for Experimental Biology in Boston, March, 1942. W. Buschke, A. A. Albanese and R. H. Follis, Jr., *Fed. Proc.*, 1: 175, 1942.

[2] P. B. Curtis, S. M. Hauge and H. R. Kraybill, *Jour. Nutr.*, 5: 502, 1932.

[3] J. R. Totter and P. L. Day, *Jour. Biol. Chem.*, 140: cxxxiv, 1941.

[4] The exact composition of the diet was as follows: Protein (acid hydrolyzed casein concentrate), 147 g; l-cystine, 1.5 g; sucrose, 150 g; starch, 420 g; agar, 20 g; salt mixture (see below), 20 g; Crisco, 190 g; Mead Johnson's cod liver oil substitute, 50 g; water to make to proper consistency. The salt mixture used had the following composition: NaCl, 18.9 g; $CaHPO_4$ anhydrous, 25.0 g; $MgSO_4$ anhydrous, 6.86 g; $KHCO_3$, 44.4 g; KCl, 2.88 g; Fe citrate U.S.P., 2.21 g; $CuSO_4$ anhydrous, 0.24 g; $MnSO_4$ anhydrous, 0.15 g; KI, 0.015 g; NaF, 0.03 g.

on a tryptophane deficient diet. Adult animals have so far failed to develop any evidence of cataract.

OTHER LESIONS IN TRYPTOPHANE DEFICIENT RATS

In addition to cataract formation, we have observed a variety of other lesions in rats on a tryptophane deficient diet.

1. *Vascularization of the cornea,* with characteristic superficial capillary loops, has developed in the majority of our tryptophane deficient rats, both adult and growing rats. This can at least be partially reversed by a tryptophane supplement.

2. *Alopecia* has developed in our animals, both young and old. In many animals, notably the young ones, it has been most conspicuous about the head and back, while in other animals it has affected primarily the back, abdomen and hindlegs. Restoration of hair growth has been observed following the administration of a tryptophane supplement.

3. *The incisor teeth* show defects in the enamel and loss of color; they are brittle and misshapen. This has been observed so far only in growing rats.

4. *Atrophy of the testis and aspermiogenesis* have been observed in male animals.[5]

It is apparent that continuously growing epithelial structures bear the brunt of the lesions in this deficiency. However, the lesions are not confined to such tissues, for there is also found a retardation of growth and a loss of skin turgor which can not be so explained. The animals exhibit a hunched posture such as is encountered in a number of other deficient states.

A CLASSIFICATION OF CATARACTS

On the basis of their morphological characteristics, their mode of development as observed with the slitlamp and their association with particular lesions in other organs we can differentiate the tryptophane deficiency cataracts from:

A. *The diabetic group of cataracts* (cataract in experimental[6] and clinical diabetes,[7] galactose[8] and xylose[9] cataracts). These are characterized in some stages by the prevalence of subcapsular vacuoles (particularly beneath the anterior lens capsule); they are associated with polyuria and polydipsia, with an abnormally high monosaccharide concentration of the blood.[9]

B. *The tetanic group of cataracts* (cataracts in idiopathic[10] and in postoperative parathyroid tetany[11] and rachitic tetany[12]) which are characterized by the zonular *development* of the cataracts in association with a diminished calcium : phosphate ratio in the blood and with the typical neuromuscular manifestations of tetany. These cataracts are occasionally accompanied by the lesions associated with group C and are probably more closely related to the latter group than to group A.

C. The third group of cataracts, in which that of tryptophane deficiency must be included, may be termed the *epitheliodystrophic group,* which includes the cataract attributed to riboflavin deficiency;[13] chronic thallium poisoning;[14] x-ray damage; the cataract of scleroderma and poikiloderma (Rothmund-Werner Syndrome);[15] of atopic eczema (Andogsky-Kugelberg Syndrome)[16] and of myotonia atrophica (Steinert-Batten-Gibb).[17] In addition to the absence of the features of group A, some of these cataracts are characterized by their polymorphism, and all of them are associated with other epithelial lesions. A more complete analysis of the classification of "metabolic" cataracts, including that of tryptophane deficiency, and a bibliography of other syndromes associated with cataract will be reported elsewhere.[18]

Among the members of group C the tryptophane deficiency cataract seems to resemble most closely the cataracts described in riboflavin deficiency and in thallium poisoning. But all the members of this group show striking similarities in their concomitant manifestations. Involvement of the cornea has been observed in connection with each of these conditions of the group, although the corneal lesions have shown some differences. Each of these conditions has been accompanied by alopecia and other skin lesions. Atrophy of the gonads has been described in all these conditions with the exception of atopic eczema. Developmental changes in the teeth have so far been observed only in tryptophane deficiency and in some cases of syndermatotic cataract.[19, 20]

COMMENT

Our finding that tryptophane deficiency gives rise to a variety of characteristic lesions lends strong support to the view that this amino acid has specific

[5] Landrum B. Shettles, personal communication.

[6] One of us (Buschke) is at present engaged with Dr. Curt P. Richter in the study of experimental diabetic cataract in rats which has made possible for the first time the comparison of diabetic and galactose cataracts in the same species.

[7] A. Meesmann, Die Mikroskopie des lebenden Auges. Berlin-Wien. Urban-Schwarzenberg, 1927.

[8] H. S. Mitchell and G. M. Cook, *Arch. Ophth.,* 19: 22, 1938.

[9] N. J. Darby and P. L. Day, *Jour. Biol. Chem.,* 123: 503, 1940.

[10] A. Meesmann, Hypocalcaemie und Linse. Stuttgart, F. Enke, 1938.

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[12] G. von Bahr, *Acta Ophth.,* 14: suppl. XI, 1936.

[13] C. S. O'Brien, *Arch. Ophth.,* 8: 880, 1932.

[14] A. Buschke, *Arch. f. Derm. Syphil.,* 116: 477, 1913. J. Donski, *Graefe's Arch. Ophth.,* 128: 294, 1932.

[15] A. Siegrist, Der graue Altersstar. Berlin-Wien, Urban-Schwarzenberg, 1928.

[16] W. P. Beetham, *Arch. Ophth.,* 24: 21, 1940.

[17] B. Fleischer, *Graefe's Arch. Ophth.,* 96: 91, 1918.

[18] W. Buschke, *Arch. Ophth.,* in prep.

[19] I. Kugelberg, *Klin. Mbl. Augenheilk.,* 92: 484, 1934.

[20] A. E. Maumence and W. Buschke, unpublished observation.

functions to perform in addition to serving as a building block for body proteins. Although the changes in tryptophane deficiency are not identical with those seen in other conditions causing epitheliodystrophic cataracts, the similarity of the pathological picture is striking and suggests that some common metabolic path is interrupted in these disturbances.

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A VIRUS INACTIVATOR FROM YEAST

THE ability of certain bacteria to inactivate tobacco mosaic virus was reported by Mulvania.[1] Johnson and Hoggan[2] found that a number of fungi as well as bacteria could cause inactivation of tobacco mosaic virus and suggested that this inactivation was most likely due to the utilization of the virus constituents by these organisms. The high rate of inactivation by *Aerobacter aerogenes* and *Aspergillus niger* later led Johnson[3] to suspect that a virus inhibitor was produced by these organisms. Broth cultures of the organisms were found to contain a growth product (or products) capable of inactivating several plant viruses *in vitro* and in dried-leaf tissue. Efforts to separate the active substance from the culture medium yielded discouraging results.[4]

Johnson and Hoggan[2] grew a yeast, *Saccharomyces sp.*, in a medium containing filtered tobacco mosaic virus and broth for 8 days, but could not detect a reduction in the concentration of virus due to the action of the yeast in this mixture. Extraction of an inhibitor from the yeast was not attempted by these workers.

In the work reported below a virus inactivator has been extracted from yeast by autolysis and by autoclaving. A simple method for extracting this substance is as follows: one kilo of frozen baker's or brewer's yeast cake is mixed with 4 liters of distilled water and autoclaved for 30 minutes at 15 pounds pressure. The autoclaved material is filtered through a pad of Celite No. 505. The pale yellow, somewhat opalescent filtrate is treated with two volumes of acetone or alcohol and the resulting bulky, white precipitate is separated from the liquid by centrifugation. The precipitate is dissolved in a volume of distilled water equal to that of the original filtrate. The precipitation and solution in water may be repeated several times, but a small amount of an electrolyte such as NaCl must be added to effect complete precipitation. This partially purified substance was used for much of the preliminary work. Later, for more exact work, the inactivator was further purified by clearing with safranine and neutral lead acetate, followed by heating in 2N HCl. In more detail, 33.3 cc of a 1 per cent. solution of safranin per liter of inactivator were used and the neutral lead acetate (saturated) was added dropwise until no further precipitation took place. Potassium oxalate and $CaCl_2$ were used to free the solution of lead and oxalate, respectively. After precipitating with acetone the supernatant liquid was discarded, the precipitate dissolved in 2N HCl and heated on a boiling water bath for ½ hour. Six to seven volumes of acetone were required to effect the final precipitation. The white precipitate was dried for several days in a desiccator, then ground into a powder before weighing.

TABLE 1

THE INACTIVATION OF PURIFIED TOBACCO MOSAIC VIRUS BY DIFFERENT CONCENTRATIONS OF A PURIFIED INACTIVATOR FROM YEAST

Milligrams of inactivator per 100 cc of a suspension containing 5 mg of virus	Local lesions on 20 half leaves		Per cent. of virus remaining active	Per cent. of virus inactivated
	Treated virus	Untreated virus		
0.303	493	1520	32.3	67.8
0.625	209	1359	14.8	85.2
1.25	164	1614	10.05	89.95
2.50	44	1398	3.14	98.86
5.00	22	1547	1.42	98.58

Each step in the purification process and the effect of different treatments were followed by mixing a solution of the test material with a solution of purified virus. The changes in virus concentration brought about by the inactivator were measured by inoculating half leaves of *Nicotiana glutinosa*. In all cases, one half of each of 20 leaves was inoculated with each treated sample and the other halves with corresponding controls. The ultracentrifugally purified tobacco mosaic virus used in these experiments was kindly supplied by Dr. W. M. Stanley, of the Rockefeller Institute for Medical Research, at Princeton, N. J.

The reaction between the inactivator and the virus is rapid. The results of a typical experiment tabulated above show that with each doubling of inactivator concentration a halving of active virus concentration takes place. This strongly suggests a chemical reaction between one unit of inactivator and one unit of virus rather than an adsorption phenomenon. Furthermore, the inactivator does not combine with heat-denatured virus. The virus-inactivator combination can be broken if the mixture is heated to 99° C. for 10 minutes.

Scions of rose, peach and pear taken from virus-

[1] M. Mulvania, *Phytopath.*, 16: 853–871, 1926.
[2] James Johnson and Isme A. Hoggan, *Phytopath.*, 27: 1014–1027, 1937.
[3] James Johnson, SCIENCE, 88: 552–553, 1938.
[4] James Johnson, *Phytopath.*, 31: 679–701, 1941.

infected parent plants were placed in a solution of the inactivator for several days and later grafted on healthy stock. This treatment did not prevent the appearance of typical symptoms of each disease. Sets of detached leaves from mosaic and healthy plants were placed with their petioles in a solution of the inactivator and in distilled water for 9 days. A study of different combinations of juices from these leaves showed that although the inactivator had entered the leaves evidence for its entrance into the living cells and the destruction of the virus therein was not conclusive.

The activity of the substance is destroyed by heating with 1N NaOH on a boiling water bath but is unaffected by 2N HCl under the same conditions. In some cases an increase in activity was detected after the acid treatment. Treatment with trypsin or emulsin does not impair its activity. The usual protein tests are negative. Microchemical analysis of the purified substance gave: N—negligible, C—39.70 per cent., H—5.85 per cent., S—0 per cent., Chlorides—1.40 per cent., and ash—negligible. Fehling's solution is not reduced, but a strongly positive Molisch's alpha-napthol test is shown. On the basis of this test and the ratio of C to H it is suggested that the substance is a polysaccharide.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW PETRI DISH COVER AND TECHNIQUE FOR USE IN THE CULTIVATION OF ANAEROBES AND MICRO-AEROPHILES

THIS Petri dish cover, which has been designed to work in combination with a solid medium containing a reducing agent, makes possible the surface cultivation of anaerobes and micro-aerophiles without the use of anaerobe jars, petrolatum seals or chemicals other than those included in the medium itself.

Any good infusion agar containing a satisfactory reducing agent is poured into the usual Petri dish and allowed to harden. Either a pour or streak plate may be made. After the agar has solidified, the Petri dish cover is replaced by the anaerobic lid (Fig. 1), which

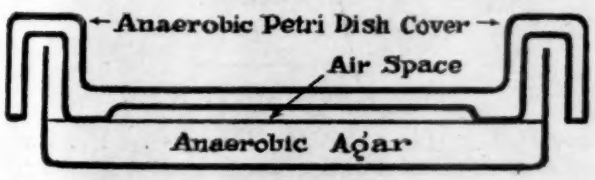

FIG. 1. Cross section showing anaerobic Petri dish cover in use.

is so designed that it touches the agar at the periphery and results in trapping a small amount of air over the surface of the agar. The reducing agent in the medium uses up the oxygen in this small amount of air and an anaerobic condition exists. The glass rim on the lid forms a seal with the moist solidified agar, and no other seal is necessary. If 1 cc of 1:500 methylene blue is added to each liter of agar to act as an indicator, the reduced center of the media in the dish becomes colorless, while the oxygenated periphery for about 5 mm remains blue.

A tentative formula for a suitable agar is as follows:

Infusion agar or blood agar base (containing 1.5 to 2 per cent. agar)	1,000 cc
Sodium Thioglycollate[1]	2 grams
Dextrose	10 grams
Methylene Blue	1 cc of 1:500 solution
pH	7.5

This agar should be distributed in about 40 cc amounts if 100 × 15 mm Petri dishes are used and 25 cc amounts if 100 × 10 mm dishes are used. The 40 cc dishes are more satisfactory and may be incubated longer without drying out. The depth of agar in the dish must be sufficient so that the rim of the anaerobic cover rests on the surface of the agar and not on the Petri dish at any point.

We have found that Cl. tetani, Cl. novyi, Cl. septique and Cl. welchii give good surface colonies in 48 to 72 hours and that the plates may be incubated several days longer without drying out. In most cases the growth was much better than that obtained with the same culture in an anaerobe jar. If an unglazed procelain top is used in pouring the plates, better isolation of surface colonies will be obtained. To facilitate opening the dish, the cover should be turned slightly to break the agar seal.

This technique may be used with the usual agar for obtaining partially anaerobic conditions for the cultivation of micro-aerophiles.

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CONTRIBUTION TO THE STEREOCHEMISTRY OF DIPHENYLPOLYENES

IN the series of the diphenylpolyenes, $C_6H_5 \cdot (CH=CH)_n \cdot C_6H_5$, which have been studied especially in the important investigations by Kuhn and Winter-

[1] One gram of sodium formaldehyde sulfoxylate and two grams of sodium thioglycollate seem to give a much quicker reduction.

stein,[1] so far as we know no stereoisomer of the all-trans compounds has hitherto been prepared in the case $n > 3$.

In a related field, that of the natural polyenes, the C_{40}-carotenoids, methods have been used in some laboratories[2] for the preparation of stereoisomers, *viz.*, reversible isomerization by refluxing solutions, by iodine or HCl catalysis, and by melting crystals. Irradiation can also be effective. As the adsorption affinity of stereoisomers varies with the configuration, they can be separated by chromatographic analysis.

We have now found that the methods mentioned are applicable to the diphenylpolyenes, in particular diphenyloctatetraene, and that the stereoisomers can be separated by developing the chromatogram with benzene-petroleum ether mixtures on calcium hydroxide. The reversibility of the trans-cis shift becomes manifest by spontaneous reisomerization, each of the separated isomers yielding a mixture in which the all-trans compound prevails. So far two new partially cis-isomers of diphenyloctatetraene have been observed below the zone of the starting material. They are followed by several minor zones which are under investigation. Since the adsorbates mentioned are almost colorless, the developing of the chromatogram has been followed by their fluorescence in ultraviolet light.

We expect to study other synthetic polyenes by the methods indicated.

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A SIMPLE MEANS OF RETAINING OIL BETWEEN SLIDE AND CONDENSER

THE condensers of most research microscopes are optically designed for homogeneous immersion against the lower surface of the slide. If the air gap is left open, only a fraction of the numerical aperture of the immersion objective is utilized.

Unfortunately, many condensers are so constructed that when a slide of the usual thickness is used, the gap between its lower surface and the top lens of the focused condenser is about 1 mm. Cedar oil does not possess sufficient surface tension to hold it in place in a gap this large. It soon runs to one side, and is in general, so troublesome that most cytologists do without it except for particular critical figures.

This difficulty can be overcome by filling most of the gap with glass, leaving only thin spaces to be filled with oil. One obtains a piece of glass of the proper thickness (I used a thin slide), and cuts a piece which will a little more than cover the top lens of the condenser. One puts a drop of oil on this glass insert and lowers it onto the condenser. One lowers the condenser slightly, then puts a drop of oil on the under surface of the slide and places the slide on the stage. One raises the condenser back into focus and optical contact is thereby established. Since the glass is of the same refractive index as the oil, it is as if the gap were filled entirely with oil. If the glass insert is not too thick, there will be no difficulty in focusing. If it is not too thin, there will be no tendency for the oil to run out. Several different inserts may be needed, for use with slides of various thickness. One can conveniently keep the condenser immersed during an entire working day. Depending on the size of the hole in the stage, a greater or lesser area of the slide can be searched without smearing. Then one must pause, wipe the oil off the under surface of the slide, put on a fresh drop in the proper place, and start again.

This method is so simple that it has probably been used before. However, it newly occurred to the author, and was new to several cytologists to whom it was mentioned.

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[1] R. Kuhn and A. Winterstein, *Helv. chim. Acta*, 11: 87, 116, 123, 144, 1928.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE X-RAY MICROSCOPE

AN "X-ray microscope" invented by Professor W. L. Bragg, of the Cavendish Laboratory of the University of Cambridge, is the newest instrument for peering into the innermost structure of matter. By its means can be seen the actual arrangement of the atoms in one layer of the crystal.

The instrument is not yet fully perfected and at present applies to only one special case. But Professor Bragg hopes to extend its applications and believes that it will then be a useful aid in crystal analysis.

The X-ray analysis of crystal structure, which won the Nobel prize for Professor Bragg and his father, the late Sir William Bragg, is of immense importance in all branches of both war-time and peace-time industrial research. On the crystalline structure depends the strength of steel girders, the toughness of armor plate, the hardness of tool steel, the properties of aluminum alloys, the lubricating qualities of paraffins and of graphite, the stretching of rubber, the covering power of pigments; in fact, nearly every aspect of the behavior of a solid substance.

But X-rays passing through a crystal do not directly reveal its structure. They produce a "diffraction pattern" of complicated design from which the positions and spacings of the atoms must be calculated. This gives the arrangement in a particular plane. To get the true arrangement in space, several such patterns must be photographed by passing the rays through the crystal in different directions. A three-dimensional model can then be made. This is a long and laborious process.

Instead of making a drawing showing the arrangement in a particular plane, Professor Bragg's apparatus forms an optical image of it which can be viewed through an ordinary optical microscope. (The name "X-ray microscope" applies to the whole apparatus.)

He drills a number of small holes through a brass plate. The sizes and arrangement of these holes are determined by the diffraction pattern. The plate is placed in the path of a beam of ordinary parallel monochromatic light. This light in passing through the small holes produces a diffraction pattern of its own which, however, on account of the carefully calculated sizes and spacings, is a replica of the arrangement of the atoms in the crystal, each spot representing an atom. The image is focused and viewed through the microscope.

Thus, X-rays passing through a crystal are diffracted by the structures they encounter, but produce a pattern bearing no resemblance to this structure. By rediffracting this pattern backwards, so to speak, with ordinary light, Professor Bragg obtains a visible image of the atomic arrangement that produced it.

To get a good image, the holes in the plate must be accurately dimensioned and spaced to better than half a wave-length of the light used. On account of this difficulty, Professor Bragg has lately devised an improved method. An enlarged drawing is made in which the holes are represented by solid black circles. This is then photographed and reduced to the proper size, the black circles being in effect converted to transparent holes. The use of this in place of the brass plate gave much better definition.

The new method was reported to *Nature*, with photographs made with the "X-ray microscope," and drawings of the same crystal structure calculated from X-ray diffraction patterns, showing close correspondence between the two.

POSSIBLE AERONAUTICAL DEVELOPMENTS

THREE aeronautical developments would upset the present more or less new military aviation race throughout the world—a successful gas turbine engine for airplanes, a practical rocket plane and the realization of an airplane wing structure that would prevent the air becoming turbulent as it flows over it.

Dr. Jerome C. Hunsaker, of the Massachusetts Institute of Technology, aeronautical engineer and chairman of the government National Advisory Committee for Aeronautics, in speaking before the Harvard War Institute listed these as the three possible developments that might with some rapidity spring a surprise. It is known that engineers throughout the world have been working attempting to achieve these objectives.

A gas turbine would be an escape from the very real task of lubricating ordinary internal combustion engines at very high temperatures, now a limit to efficient operation. Present engines waste a third of the gasoline power in heat. Successful gas turbines operating on waste gases from diesel engines and the oil refining process have been perfected and are in use in Switzerland and in this country. The gas turbine in the airplane would eliminate the cooling system and also allow operation at 10,000 to 12,000 revolutions per minute instead of the 3,000 of the present engines.

Rocket planes avoid all engines and propellers, the propulsion being given by the kick of the rush of the gases out of an orifice at the rear of the plane. The Italians have already flown a small rocket plane from Milan to Rome. Rocket propulsion would be particularly effective in the high altitudes where the air is rare because the rocket kick doesn't need air to operate.

Making air flow smoothly over an airplane wing so as to maintain its untroubled characteristics might reduce the resistance or drag offered by the airplane by half. This is a major problem that might make a big difference in the performance of airplanes in the future if it could be solved.—WATSON DAVIS.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

BY January, 1943, a new force of 172,000 young men and women will be ready to tackle the technical problems of war for Government and war industries. Already they are streaming from colleges, universities and technical schools as a result of speed-ups in educational programs

This is shown in a count just completed of college dents being trained for 103 war-vital occupations as eked by the National Roster of Scientific and Special- d Personnel. The survey was conducted by the Ameri- n Council of Education at the special request of the tional Resources Planning Board.

A majority of the 812 institutions surveyed are already aching a capacity load of students in the fields where anpower shortages are developing, was indicated by Dr. S. Marsh, vice-president, in his report of the survey. urses are being compacted, vacations shortened and the ree-term college year is being substituted for the time- nored semester system.

Graduation comes at least a month earlier than it used in the majority of the institutions studied. One tech- logical school is delivering to industry twice its usual mber of trained youth, and is doing it in sixteen months s time.

Seasonal peaks are also being ironed out of the college- ained manpower supply by changes in teaching policy d speed-ups of courses. Although June is still the vorite month for cap-and-gown processions and the arding of degrees, there is now a steadier flow through- t the whole year. This is the tempo at which 1942's aduates will become available for war employment:

Already graduated in February or March, 12,000; in pril or May, 43,000; June or July, 74,000; August or ptember, 13,000; December or January, 1943, 29,000.

Special courses have been organized by colleges to aid the war program. Many have night classes in the SMDT (engineering, science, and management defense aining) courses administered by the U. S. Office of ducation. Others have turned over dormitories and assrooms for use of Army and Navy fliers. Laboratories ve been turned over to the Government for military search and faculty members have been loaned.

Special courses bearing on war problems, such as mouflage, explosives, tactics, map-making, radio com- unication, cryptography and military law have been ganized.

The colleges and universities are facing a manpower oblem of their own, meantime. Skilled scientists are ing taken from teaching jobs to carry on military re- arch. Enrollments of students are dropping off, too, t this does not balance the loss of faculty members. he professors most needed in war research are those aching in the physical sciences. Their loss is not bal- ced by the drop in numbers of music students. Student rollments have decreased most sharply in the liberal ts courses, teacher training and law schools.—MARJORIE AN DE WATER.

ITEMS

MEDICAL students who have completed advanced Re- rve Officers' Training Corps courses will have a chance complete their medical course before being called to tive duty, according to the War Department. If they ve been accepted as matriculants in an approved medi- l school, they will be commissioned second lieutenants the U. S. Army and placed on deferred duty status. ey will be commissioned in the arm or service in which e training was received rather than in the Medical Administrative Corps. Those who have completed all requirements for the commission before entering medical school except the practical training at the appropriate service school will be required to attend the service school if the date of their entrance into medical school permits. If it does not, they will be permitted to withdraw from their R.O.T.C. course contracts, will be commissioned as second lieutenants in the Medical Administrative Corps and will be placed on deferred duty status until their medical training has been completed or discontinued.

PINE, spruce and other conifer seedlings frequently fail to grow when transplanted into prairie soil. Cause for these losses has been traced to lack of a certain type of fungous growth on their roots, by A. L. McComb and J. E. Sass, of the Iowa State College. Seedling loss was particularly troublesome on new nursery sites, where seedlings of jack pine, Norway spruce and other conifer species produced weak, straggly growth, or died when only a few inches high. Roots of these seedlings were found to be uninfected with the fungal threads known as mycorrhiza, which are found in the root tissues of healthy trees. Botanists believe that these fungi aid the trees in absorbing food materials from the soil. The situation was remedied by inoculating the soil with surface litter from an older coniferous plantation, which contained the necessary fungi. Phosphorus seems to be the chief plant food material which the fungi enable the trees to absorb. Application of phosphate fertilizer without soil inoculation resulted in satisfactory growth, and the fungi appeared on fertilized seedlings.

PERISHABLE foods are now being made to refrigerate themselves on American cargo ships, using an ingenious plan made public by the United States Department of Agriculture. Lard, chilled to a zero temperature or lower, is the refrigerating agent. By lining the holds of ocean-going ships with insulating material, packing large containers of the refrigerated lard to form a floor and walls around perishable foodstuffs, placing more lard over the top, and adding a final cover of insulation, the shipment is kept safely cold until it reaches its destination in England or Russia. The system has been adopted to keep Axis submarines from stopping shipment of perishables to United Nations ports by systematically sinking refrigerator ships. It has the added advantage of saving space which refrigerating machinery would occupy.

USE of sound waves to improve sulfa drug treatment of wounds, infections and burns is announced by Dr. Leslie A. Chambers, Dr. T. N. Harris, Dr. Francis Schumann and Dr. L. Kraeer Ferguson, of Philadelphia, in the *Journal* of the American Medical Association. The sonic vibration is used to break up sulfathiazole crystals into microscopic bits which when suspended in water or salt solution gives a preparation with the consistency of thick cream. This preparation can be injected through fine gauge hypodermic needles, which is usually not possible with neutral suspensions of ordinary sulfa drug crystals because of their larger size and irregular shape. The microanalysis of sulfathiazole can get to work faster at their job of stopping germ invasion because they dissolve more rapidly and do not clump or cake.